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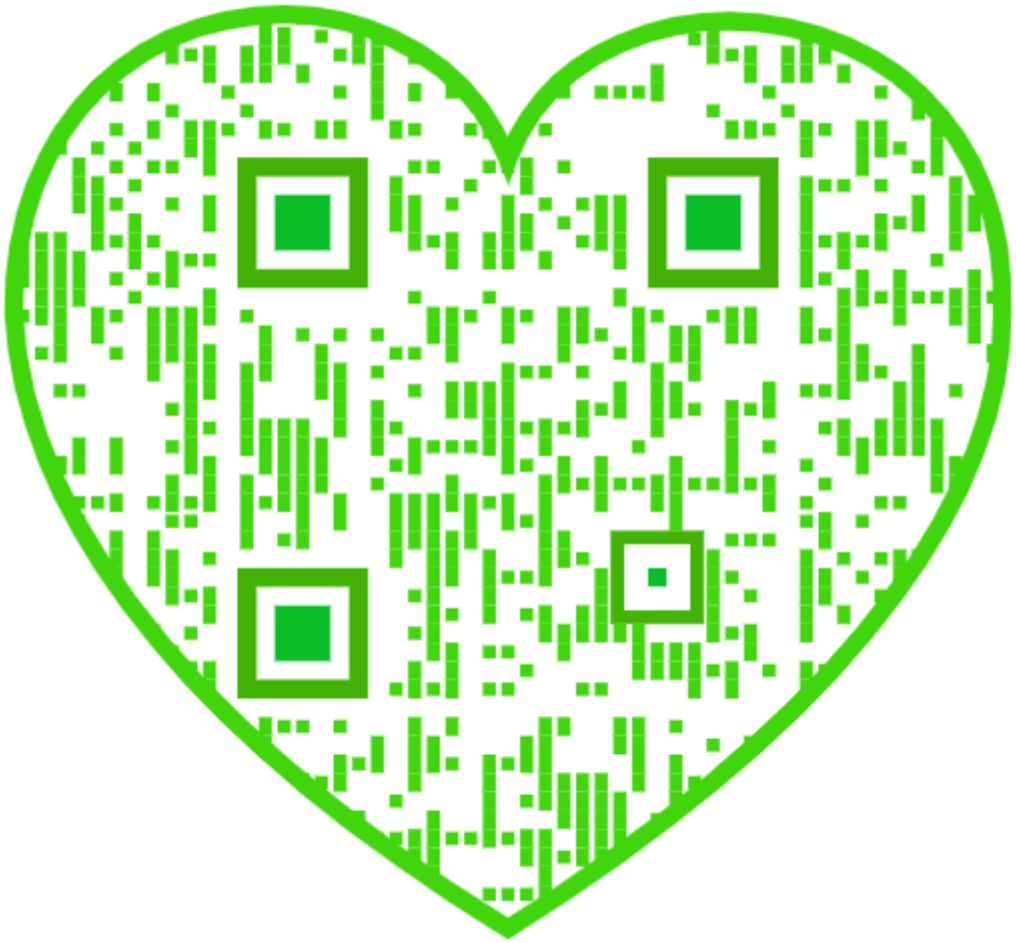

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U. S. DEPARTMENT OF AGRICULTURE.

WEATHER BUREAU.

WEATHER FOLK-LORE

AND

LOCAL WEATHER SIGNS.

Prepared under the direction of WILLIS L. MOORE, Chief U. S. Weather Bureau.

BY

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PROFESSOR OF METEOROLOGY.

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WEATHER FOLKLORE.

INTRODUCTION.

It is safe to assume that our first parents acquired weather wisdom by observing weather sequences and noting the foreshadowed effects of certain atmospheric conditions on objects animate and inanimate. We may assume further that the knowledge thus acquired was communicated to their descendants, and that it was handed down, with additions and amplifications, from generation to generation. We find in the earliest writings and in the Scriptures expressions of weather wisdom, many of which appear in collections of the popular weather sayings of to-day. Thus by assumption and deduction we know that man has ever employed inherited and acquired weather wisdom in the daily affairs of life. When flocks and herds have constituted his earthly possessions he has been prompted to lead his charges to places of safety when signs of impending storms appeared. As a navigator his interpretation of the signs of the air has, in innumerable instances, enabled him to adopt measures calculated to avert disaster to his frail craft. As an husbandman he has closely scanned the sky, the air, and the earth for signs that would indicate the weather of the coming day and season.

The wisdom thus acquired has been perpetuated in the form of trite sayings or proverbs. Many of these sayings are polished gems of weather lore, others have lost their potency by transfer to foreign lands where dissimilar climatic conditions obtain, and a large proportion have been born of fancy and superstition.

The object of this paper is to segregate from the mass of available data the true sayings that are applicable to the United States, and to combine the material thus collected with reports on local weather signs that have been officially and specially prepared by observers of the United States Weather Bureau.

The laws that govern the distribution of the earth's atmosphere and control its phenomena necessarily produce different results on different parts of the earth's surface. The seasonal distribution of the atmosphere, as indicated by the greater, or so-called permanent, areas of high and low barometric pressure, is governed largely by the temperature of the land and water surfaces. In summer the pressure of the

atmosphere is greater and its surface temperature is lower over the oceans than over the continents, and in winter the reverse of these conditions obtains. And the differences in atmospheric pressure and temperature control the seasonal directions of the winds. Similarly the smaller areas of high and low barometric pressure that appear on our daily weather maps produce the varying temperatures and winds, and, incidentally, the weather that we experience from day to day.

In the United States the centers of areas of high barometric pressure generally move in a south of east direction immediately preceded by winds that blow from points between west and north, low temperature for the season, and fair weather. Areas of low barometric pressure, or general storms, usually move in a north of east direction, and the winds in their east quadrants blow from easterly or southerly points of the compass, with high temperature for the season, and precipitation in the form of rain or snow.

Chart No. I shows the distribution of atmospheric pressure and temperature, the circulation of the winds, and the general character of the weather that attends the passage of well-defined areas of high and low barometric pressure over the United States.

It will be observed from the foregoing remarks and Chart No. I that wind directions, as influenced by areas of high and low barometric pressure, produce high and low temperatures, fair and foul weather, and the fact will be recognized that all true popular weather sayings of ancient origin have been coined from the utterances, born of experience, of men who have observed, without understanding the causes thereof, the first indications of approaching weather changes.

References and sayings relating to wind, clouds, atmospheric pressure, temperature, and moisture, the habits and actions of animals and birds, and to plant life will in turn be briefly quoted and discussed, and reference will be made to sayings regarding times, days, and seasons, and the sun, moon, and stars. Many of the sayings quoted have been taken from Weather Proverbs, 1883, by Col. H. H. C. Dunwoody, U. S. Army, and Weather Lore, 1893, by Richard Inwards, F. R. A. S. Finally a summary, illustrated by charts, will be given of local weather signs as observed at regular stations of the Weather Bureau.

WIND.

Every wind has its weather.—*Bacon.*

Charts II to V show, for the several seasons, the winds that usually precede the beginning of rain or snow in the United States.

Weather proverbs that have been based upon observations of the wind conform to a notable degree with modern meteorological knowledge. In the temperate zone of the Northern Hemisphere easterly winds are proverbially rain winds and westerly winds are invariably

associated with fair or clearing weather. The reason for this is apparent when the circulation of winds about areas of high barometric pressure, and areas of low barometric pressure, or general storms, is observed.

The Temple of the Winds at Athens indicates the knowledge possessed by the Greeks of the weather that is associated with winds from the various points of the compass. It is a little marble octagon tower, the eight sides of which are built to face the eight principal winds, and on each side is sculptured a human figure, symbolizing the character and qualities of the particular wind it faces. The north wind, which is cold, is represented by the figure of a man warmly clad and blowing on a trumpet made out of a seashell. The northeast wind, which brought, and still brings, to the Athenians cold, snow, and sleet or hail, is figured by an old man with a severe countenance, who is rattling slingstones in a shield, expressing emblematically the noise and power of a hailstorm. The east wind, which brings to Athens rain favorable to the growth of vegetation, is expressed by the image of a young man with flowing hair and open countenance, having his looped-up mantle filled with fruit, honeycomb, and corn. The west wind is indicated by the figure of a slightly-clad and beautiful youth with his lap full of flowers. And so on with the winds from all around the compass, each has its qualities fixed in stone by its appropriate sculptured figure, and thus modern science learns from ancient poetry and art the fact that the climate of Greece has not materially changed, at any rate in respect to winds, after the lapse of about twenty centuries.

When the wind is in the north,
The skillful fisher goes not forth;
When the wind is in the east,
'Tis good for neither man nor beast;
When the wind is in the south,
It blows the flies in the fish's mouth;
When the wind is in the west,
There it is the very best.

Isaak Walton.

The terms employed in many proverbs to indicate wind directions are indefinite and confusing. The term north or northerly is often indiscriminately applied to winds blowing from the north quadrants, or from a range of 180° of the compass. As a matter of fact, a variation of the wind of a few points in the compass frequently changes absolutely the character of the weather that it indicates. In the case of north or northerly winds, directions from a few points east of north indicate rain or snow and ofttimes the severest storms to which a great part of the United States is subject. On the other hand, winds from points west of north generally indicate fair or clearing weather. East or easterly winds blow from the eastern quadrants, or from the

180° of the compass between north and south by way of east. From 90° of this semicircle, or from points between east and north, the winds often indicate, as before stated, our most violent storms of wind and snow or rain, while following winds from the southeast quadrant the character of the storms is less severe. South or southerly winds are, in many cases, considered as winds that blow from any part of the southern quadrants. These quadrants also cover one-half of the points of the compass, and their winds indicate weather of a very different character. Winds from the southeast quadrant are rain winds, and those from the southwest quadrant are fair-weather winds. Westerly winds, both from the northwest and the southwest quadrants, are, essentially, fair weather winds, the principal distinction between these winds being that the southwest winds are warm and the northwest winds are cold.

A veering wind, fair weather;
A backing wind, foul weather.

If the wind back against the sun,
Trust it not, for back it will run.

Whether the wind backs or veers depends upon the position of the observer with reference to the approaching or passing storm. If a storm center approaching from a westerly direction passes south of the observer, the wind will back from easterly to westerly by way of north; if the storm center passes north of the observer, the wind will veer from easterly to westerly directions by way of south. When the wind is from a southerly direction and veers to westerly, fair weather will follow; when, on the contrary, it backs from southerly to easterly points, foul weather is likely to follow. The sayings regarding veering and backing winds hold good, therefore, only when the winds veer or back from southerly directions.

In Texas and the Southwest when the wind shifts, with strength, during a drought, expect rain.

In the West and Southwest when brisk winds from the south continue for a day or more, expect a "norther."

Over a great part of the United States a steady and strong south-to-east wind will bring rain within thirty-six hours.

Easterly winds are proverbially bringers of rain, and when they blow from the northeast quadrant in winter heavy snow is likely to be followed by severe cold.

When, during a storm, the wind shifts from the east to the west quadrants, clearing weather will soon follow.

When the wind is from points between west and north and the temperature falls to 40° or below, frost will probably occur.

The strength of the wind and the severity of storms depends upon barometric conditions.

Westerly winds (southwest to northwest) are fair-weather winds.

WEST INDIAN HURRICANES.

During the late summer and early fall months hurricanes occasionally develop in the tropical regions of the Atlantic, near the southern edge of the northeast trade winds, and move westward over or near the West Indies into the Gulf of Mexico or to the southern coasts of the United States. Some of these storms recurve northwestward and then northeastward near the Atlantic coast of the United States, and others recurve northward over the Gulf of Mexico. West Indian hurricanes are the most violent and destructive storms that visit the eastern part of the United States. Happily, their visits to our coasts are not frequent; and their visitations to any individual island of the Windward West Indian group, which lies in the most frequented path of hurricanes, are on an average limited to about one in fifteen to twenty years.

As the tropical storms of the Atlantic move from east to west, the winds that indicate their approach necessarily differ from those that are noted in advance of continental storms of the middle latitudes that move from west to east. In the tropical and subtropical regions of the Atlantic Ocean and the Gulf of Mexico the approach of a hurricane from the eastward is indicated by north to northwest winds, which increase in force as the vortex of the storm approaches. The shift of the winds depends upon whether the center of the storm passes south or north of the observer. If it passes to the southward, the wind goes from northerly to easterly and southerly; if it passes to the northward, the wind goes from northerly to southerly by way of west.

West Indian hurricanes are preceded one to two days by barometer rising slowly above the normal and an unusually clear, cool atmosphere. These conditions are followed by a fall in the barometer and, generally, by a greasy-looking halo around the sun or moon, and by high cirrus or cirro-stratus clouds that are projected in advance of the vortex of the storm. Tufted or rolled clouds with lurid streaks of light and unusual atmospheric colors are in turn followed by rapidly falling barometer and a heavy bank of clouds in the horizon in and from which lightning flashes appear. This is the cloud mass that surrounds the center of the hurricane, which advances westward, in the tropical and subtropical regions, with a velocity of 15 to 20 miles an hour. Closely following the appearance of the cloud mass that surrounds the vortex of the storm, the barometer falls with great rapidity and the wind increases to hurricane force from the north quadrants, the direction within the range of these quadrants being governed by the position of the observer with reference to the path of the storm. The vortex of a hurricane is comparatively small, averaging probably 8 to 10 miles in diameter. In the central area of the vortex the sky overhead is often clear, and light confused winds are experienced. As

a rule, places in the direct path of the vortex will experience this period of calm for a period of about one-half hour, when the hurricane winds will again set in from a quarter opposite to that from which they were previously blowing. The barometer then rises rapidly, the winds diminish, and the weather gradually clears. The great whirlwind has passed on its westward course. At the point where, from natural causes, that differ in different cases, the hurricane makes its recurve to the northward its speed lessens to 8 or 10 miles an hour, and its strength often increases. After the recurve to the northeastward has been made and the storm enters the middle latitudes of the ocean or of the United States, its area increases and its intensity generally diminishes.

The West Indian hurricane season is confined practically to the months of August, September, and October. Storms of this class sometimes occur, however, as early as June and as late as November.

The following lines regarding the tropical hurricanes of the Atlantic cover, in the opinion of mariners, the season of their probable occurrence:

June, too soon;
July, stand by;
August, look out you must;
September, remember;
October, all over.

—*Captain Nares.*

The tropical storms of the Pacific Ocean that originate near or to the eastward of the Philippine Islands and move thence westward over the China Sea, or northward near the China and Japan coasts, are called typhoons. These storms present the characteristics noted in connection with West Indian hurricanes. Their season is, however, longer, extending from July to November, with August and September as the months of greatest typhoon frequency. The Indian Ocean and the Bay of Bengal also have storms that conform in character to West Indian hurricanes. Cyclones is the very proper name that is applied to these storms. Their season appears to be somewhat longer than that of the typhoons, and the season of the Bay of Bengal cyclones is assumed as extending from May to November, with occasional storms in April and December.

In addition to the gyrating wind storms enumerated, the greater continental areas, and more especially their coast districts, are subject to strong seasonal winds that result from marked atmospheric pressure and temperature gradients that exist between their coastal and interior regions. The most pronounced winds of this type are the monsoons of southern and southeastern Asia and adjacent waters. The monsoons of southern Asia are due, during the warmer months, to the summer area of low barometric pressure that covers the warm interior of eastern Asia, whereby strong wind currents—the summer

monsoons—are drawn from the southern coasts and oceans; and during the colder months, when the interior of Asia is occupied by an area of high barometric pressure of great magnitude, the direction of the monsoon winds is reversed and they blow from the interior over the coasts. The change in the winds or, as it is termed, "the bursting of the monsoon," occurs in May and October, and the winds of these months are often very severe.

During the summer months the greater desert areas are the breeding places of violent whirling storms that are generated by the intense heat of those regions; and the deserts, and the regions that border them, are also swept by strong straight winds that are promoted by sharp gradients in temperature that exist between the desert surfaces and the cooler districts that surround them.

Thus it appears that in various parts of the world, winds, by whatever name they may be known, and in the various forms in which they are experienced, owe their origin primarily to differences in temperature in the atmosphere that overlies the land and water surfaces.

As wind directions and velocities are immediately associated with the distribution of atmospheric pressure, as indicated on weather maps by areas of high and low barometer, the value of systematic observations of the winds in foreseeing weather changes will be discussed under the head "Barometer."

CLOUDS.

Clouds are the storm signals of the sky.

Cloud formation is the beginning of the rain or snow producing process. When the process by which the aqueous vapor of the atmosphere is precipitated or condensed is feeble, clouds only are produced; when the process is stronger, or becomes more active, at the cloud levels, rain or snow results.

Charts VI to IX show the direction of movement of cirrus and cirro-stratus clouds in the United States in the several seasons of the year, and the average time, in hours, of their appearance before precipitation begins, or the average time that elapses between the appearance of these clouds and the development of wind and barometric conditions that in a greater or less degree favor precipitation in the form of rain or snow.

In the United States, and more especially in the middle and northern districts, true cirrus and cirro-stratus clouds are almost invariably observed moving from points between southwest and northwest. The appearance of clouds of this type indicates the presence, or at least the partial development, of a barometric depression to the westward. They are formed by the condensation, in high altitudes and at low temperatures, of the moisture in the air that overflows and is projected eastward from areas of low barometric pressure. When the

depressions possess sufficient strength, rain or snow follows the appearance of the clouds within eighteen to thirty-six hours. In such cases the cirrus clouds appear to thicken and merge into cirro-stratus, then into alto-stratus, and finally into stratus and nimbus, when precipitation begins. The lower clouds possess but little value as rain indicators for the reason that they usually come with the rain or precede by very short periods the beginning of precipitation.

Mackerel scales and mare's tails
Make lofty ships carry low sails.

Mackerel clouds in sky,
Expect more wet than dry.

A mackerel sky,
Not twenty-four hours dry.

When cirrus merge into cirro-stratus, and when cumulus increase toward evening and become lower, expect wet weather.

After fine, clear weather the first signs in the sky of a coming change are usually light streaks, curls, wisps, or mottled patches of white distant clouds, which increase and are followed by an overcasting of murky vapor that grows into cloudliness. Usually the higher and more distant such clouds seem to be, the more gradual but general the coming change of weather will prove.—*Fitzroy.*

When cirro-cumulûs clouds appear in winter, expect warm and wet weather. When threads of cirrus clouds are brushed back from a westerly direction, expect rain and wind.

If cirrus clouds dissolve and appear to vanish, it is an indication of fine weather.

The mackerel clouds always indicate storm if they first appear about 15° north of west. (Kansas.)

The longer the dry weather has lasted, the less is rain likely to follow the cloudiness of cirrus.

If cirrus clouds form in fine weather with a falling barometer, it is almost sure to rain.—*Howard.*

Cirrus clouds announce the east wind. If their streaks point upward, they indicate rain; if downward, wind and dry weather.—*Howard.*

When cloud streamers point upward, the clouds are falling, or descending, and rain is indicated; when cloud streamers point downward, the clouds are ascending, and dry weather is indicated.

Enough blue sky in the northwest to make a Scotchman a jacket is a sign of approaching clear weather.

When on clear days isolated clouds drive over the zenith from the rain-wind side, rain or snow will follow within twenty-four hours—more likely within a few hours.

Clouds flying against the wind indicate rain.

It will not rain much as long as the sky is clear before the wind; but when clouds fall in against the wind, rain will soon follow.

Evening red and morning gray
Will set the traveler on his way;
But evening gray and morning red
Will bring down rain upon his head.

When it is evening, ye say it will be fair weather, for the sky is red; and in the morning it will be foul weather to-day, for the sky is red and lowering.—*Matthew, xvi, 2, 3.*

When a heavy cloud comes up in the southwest, and seems to settle back again, look out for a storm.

When ye see a cloud rise out of the west, straightway ye say: There cometh a shower; and so it is.—*Luke, xii, 54.*

If clouds at the same height drive up with the wind, and gradually become thinner and descend, expect fine weather.

If the upper current of clouds come from the northwest in the morning, a fine day will ensue.

A sky covered with clouds need not cause apprehension, if the latter are high, and of no great density, and the air is still, the barometer at the same time being high. Rain falling under such circumstances is generally light, or of not long continuance.—*Jenyns.*

It never clouds up in a June night for a rain.

If two strata of clouds appear in hot weather to move in different directions, they indicate thunder.

If clouds float at different heights and rates, but generally in opposite directions, expect heavy rains.

A horizontal streak or band of clouds immediately in front of the mountains on the east side of Salt Lake Valley is an indication of rain within one or two days. When black clouds cover the western horizon, rain will follow soon, and extend to the eastward over the valley.—*Observer at Salt Lake.*

General squalls are preceded, accompanied, or followed by clouds; but the dangerous white squall of the West Indies is indicated only by a rushing sound and by white wave crests to windward.—*Fitzroy.*

A small, fast-growing black cloud in violent motion, seen in the Tropics, is called the "bull's eye," and precedes the most terrible hurricanes.

When you observe greenish-tinted masses of composite cloud collect in the southeast and remain there for several hours, expect a succession of heavy rains and gales.

When the clouds rise in terraces of white, soon will the country of the corn priests be pierced with the arrows of rain. (Zuñi Indians.)

When the cumulus clouds are smaller at sunset than they were at noon, expect fair weather.

When cumulus clouds become heaped up to leeward during a strong wind at sunset, thunder may be expected during the night.

Well-defined cumulus clouds forming a few hours after sunrise, increasing toward the middle of the day, and decreasing toward evening are indicative of settled weather; if instead of subsiding in the evening and leaving the sky clear they keep increasing, they are indicative of wet.—*Jenyns.*

Clouds upon hills, if rising, do not bring rain; if falling, rain follows.

When Lookout Mountain (Tennessee) has its cap on, it will rain in six hours.

BAROMETER.

At the level of the sea the weight of the atmosphere is about 14 pounds to every square inch, or about 1 ton to every square foot of the earth's surface. The barometer is used to gauge the weight or pressure of the atmosphere. This pressure is constantly varying, and the variations are instantly and accurately indicated by standard mercurial barometers. The indications thus furnished by the barometer

are the best guide we now have for determining future weather conditions. As low barometer readings generally attend stormy weather, and high barometer readings are usually associated with clearing or fair weather, it follows that, as a rule, falling barometer indicates precipitation and wind, and rising barometer fair weather or the approach of fair weather. Upon the rapidity of the barometric changes depends the character of the weather that follows. As atmospheric waves and depressions are, by natural laws, caused to assume circular or oval forms, the wind directions with reference to barometric depressions, or areas of low barometer, are spirally inward toward the region of lowest atmospheric pressure, as indicated by readings of the barometer. The areas of low barometric pressure are, in fact, whirlwinds of greater or less magnitude and intensity, depending upon the steepness of the barometric gradient. The crests of the atmospheric waves, on the contrary, show winds flowing spirally outward from the region of highest barometric pressure.

The wind directions thus produced give rise to, and are responsible for, all local weather signs. The south winds bring warmth, the north winds cold, the east winds, in the middle latitudes, indicate the approach from the westward of a low barometer, or storm area, and the west winds show that the storm area has passed to the eastward. The indications of the barometer generally forerun the shifts of the wind. This much is shown by local observations.

In modern meteorological work, as conducted by the United States Weather Bureau, observations, simultaneously taken, are collected by telegraph from great areas, and it is possible by this means to calculate for periods of one to three days in advance the local signs that will be produced by the general conditions that are presented. In other words, modern meteorological appliances, methods, and skill make possible forecasts of the conditions that produce the local signs upon which all weather proverbs are based. Furthermore, it is now practicable not only to forecast general weather changes, but also to calculate with great accuracy the intensity and duration of storms.

The barometer and wind indications for the United States are generally summarized in the following table:

Barometer reduced to sea level.	Wind direction.	Character of weather indicated.
30.10 to 30.20 and steady	SW. to NW.	Fair with slight temperature changes for 1 to 2 days.
30.10 to 30.20 and rising rapidly	SW. to NW.	Fair followed within 2 days by warmer and rain.
30.10 to 30.20 and falling slowly	SW. to NW.	Warmer with rain in 24 to 36 hours.
30.10 to 30.20 and falling rapidly	SW. to NW.	Warmer with rain in 18 to 24 hours.
30.20 and above and stationary	SW. to NW.	Continued fair with no decided temperature change.
30.20 and above and falling slowly	SW. to NW.	Slowly rising temperature and fair for 2 days.
30.10 to 30.20 and falling slowly	S. to SE.	Rain within 24 hours.
30.10 to 30.20 and falling rapidly	S. to SE.	Wind increasing in force with rain within 12 to 24 hours.
30.10 to 30.20 and falling slowly	SE. to NE.	Rain in 12 to 18 hours.
30.10 to 30.20 and falling rapidly	SE. to NE.	Increasing wind with rain within 12 hours.
30.10 and above and falling slowly	E. to NE.	In summer, with light winds, rain may not fall for several days. In winter rain within 24 hours.

Barometer reduced to sea level.	Wind direction.	Character of weather indicated.
30.10 and above and falling rapidly..	E. to NE....	In summer rain probable within 12 to 24 hours. In winter rain or snow, with increasing winds, will often set in, when the barometer begins to fall and the wind sets in from the NE.
30 or below and falling slowly.....	SE. to NE...	Rain will continue 1 to 2 days.
30 or below and falling rapidly.....	SE. to NE...	Rain with high wind, followed within 24 hours by clearing and cooler.
30 or below and rising slowly.....	S. to SW	Clearing within a few hours, and continued fair for several days.
29.80 or below and falling rapidly ...	S. to E.....	Severe storm of wind and rain or snow imminent, followed within 24 hours by clearing and colder.
29.80 or below and falling rapidly ...	E. to N	Severe northeast gales and heavy rain or snow, followed in winter by a cold wave.
29.80 or below and rising rapidly	Going to W.	Clearing and colder.

Northerly and southerly winds may be classed with either fair or storm winds. When they blow from points west of north and south they are fair-weather winds; when from points east of north and south they are foul-weather winds.

During the colder months, when the land temperatures are below the water temperatures of the oceans and the Gulf of Mexico, precipitation will begin when the wind shifts and blows steadily from the water over the land without regard to the height of the barometer. In such cases the moisture in the warm ocean winds is condensed by the cold of the continental area. During the summer months, on the contrary, the on-shore winds are not necessarily rain winds, for the reason that they are cooler than the land surfaces and their capacity for moisture is increased by the warmth that is communicated to them by the land surface. In such cases thunderstorms commonly occur when the ocean winds are intercepted by mountain ranges or peaks. If, however, the easterly winds increase in force, with falling barometer, the approach of an area of low barometric pressure from the westward is indicated and rain will follow within a day or two.

Rapid changes in the barometer indicate early and marked changes in the weather.

A sudden rise in the barometer is very nearly as dangerous as a sudden fall, because it shows that the level is unsteady. In an ordinary gale the wind often blows hardest when the barometer is just beginning to rise, directly after having been very low.

Should the barometer continue low when the sky becomes clear, expect more rain within twenty-four hours.—*C. L. Prince.*

If the barometer fall gradually for several days during the continuance of fine weather, much wet will probably ensue in the end. In like manner, if it keep rising while the wet continues, the weather, after a day or two, is likely to set in fair for some time.—*Jenyns.*

A very low barometer is usually attendant upon stormy weather, with wind and rain at intervals, but the latter not necessarily in any great quantity. If the weather, notwithstanding a very low barometer, is fine and calm, it is not to be depended upon; a change may come on very suddenly.—*Jenyns.*

If the barometer and thermometer both rise together,
It is a very sure sign of coming fine weather.

If the barometer falls two or three tenths of an inch in four hours, expect a gale of wind.—*C. L. Prince.*

If you observe that the surface of the mercury in the barometer vibrates upon the approach of a storm, you may expect the gale to be severe.—*C. L. Prince.*

In summer, when the barometer falls suddenly, expect a thunderstorm; and if it does not rise again when the storm ceases, there will be several days of unsettled weather.—*C. L. Prince.*

A summer thunderstorm which does not much depress the barometer will be very local and of slight consequence.—*C. L. Prince.*

When the barometer falls considerably without any particular change of weather, you may be certain that a violent storm is raging at a distance.—*C. L. Prince.*

In winter heavy rain is indicated by a decrease of pressure and an increase in temperature.—*C. L. Prince.*

The barometer falls lower for high winds than for heavy rain.

When the glass falls low,
Prepare for a blow;
When it rises high,
Let all your kites fly.
—*Nautical.*

First rise after low,
Foretells stronger blow;
Long foretold (falling), long last;
Short notice, soon past.
—*Fitzroy.*

Charts X to XIII show, for various sections of the United States, the point to which the barometer falls, in the several seasons, before precipitation begins. These readings apply more particularly to storms that advance from the west and northwest, and records show, in connection with storms that advance from the directions named, that precipitation seldom begins before the barometer falls to or below the figures given. In the case of storms that advance from the southwest or south, which are indicated by winds blowing from points between east and north, precipitation will, as before stated, often begin when the barometer begins to fall.

From the Mississippi and Missouri valleys to the Atlantic coast, and on the Pacific coast, rain generally begins on a falling barometer, while in the Rocky Mountain and plateau districts, and on the eastern Rocky Mountain slope, precipitation seldom begins until the barometer begins to rise, after a fall. This is true as regards the eastern half of the country, however, only during the colder months, and in the presence of general storms that may occur at other seasons. In the warmer months summer showers and thunderstorms usually come about the time the barometer turns from falling to rising. The fact that during practically the entire year precipitation on the great western plains and in the mountain regions that lie between the plains and the Pacific coast districts does not begin until the center of the low barometer area has passed to the eastward or southward and the wind has shifted to the northern quadrants, with rising barometer, is an important one to the forecaster.

UNSEASONABLE WEATHER DUE TO ABNORMAL BAROMETRIC CONDITIONS.

As local weather conditions are associated with the areas of high and low barometric pressure that appear on our daily weather maps, so are these areas of high and low pressure apparently controlled, both as regards intensity and movement by the great so-called permanent continental and oceanic areas of high and low barometer. The apparent relations referred to are discussed by the writer as follows in the Monthly Weather Review for June, 1902:

The cause of unseasonable weather is not demonstrable. Neither is it possible in all cases to determine which of the general atmospheric conditions that are associated with unseasonable weather partake of the nature of cause and which of effect.

It has been observed that summer periods of low temperature are associated with barometric pressure below the normal and abundant rainfall, and that summer periods of excessive heat are associated with barometric pressure about or above the normal and a marked deficiency in rainfall. It has also been observed that winter periods of excessive cold are associated with barometric pressure above the normal and little or no precipitation, and that periods of high temperature in winter are associated with barometric pressure below the normal and rain or snow. It has been observed further that the general atmospheric conditions referred to are associated with areas of high and low barometric pressure that traverse the United States. In summer the atmosphere over regions subjected to unusual cold and abnormally heavy rainfall is dominated by areas of low barometric pressure, or general storms that follow unusual tracks for the season, and the atmosphere over regions subjected to unusual heat is undisturbed by the passage of general storms, and is dominated by an extensive and almost stationary area of high barometric pressure. In winter periods of excessive cold are experienced in connection with areas of high barometric pressure of great magnitude that advance from the British Northwest Territory, and also in connection with general storms that follow abnormal southerly paths, and periods of unusually warm weather occur in connection with a succession of general storms that pursue abnormal northerly paths.

A study of the daily meteorological charts of the Northern Hemisphere shows that the general atmospheric conditions over the United States that are associated with unseasonable weather in any part of the country are, in turn, associated with atmospheric conditions that obtain over at least a great part of the Northern Hemisphere. The international charts show that when a period of abnormal weather prevails over a considerable area of the United States, there is a disarrangement of the normal distribution of atmospheric pressure over a great part of the Northern Hemisphere. They show that in the presence of unseasonable weather in any part of the Northern Hemisphere the so-called permanent continental and oceanic areas of high and low barometric pressure present abnormal aspects, and there is an interruption in the normal succession and progression of the areas of high and low barometric pressure of the middle latitudes.

Admitting the possibility of a primary cause of unseasonable weather that first affects the earth's atmosphere as a whole, by disarranging the normal distribution of atmospheric pressure and finally interrupts the usual succession over the continents and oceans of areas of high barometer and general storms, there is presented a fascinating field for speculation and study. Speculation regarding the nature of the cause would naturally be directed toward supposed evidence of solar disturbances as indicated by sun spots, to manifestations of the electro-magnetic influence of the sun's radiant energy, or perhaps to planetary or other equally obscure and possibly

imaginary influences. Study should begin with facts presented at the surface of the earth. In the outline of these facts the association of periods of unseasonable weather with local, continental, and hemispherical barometric pressure has been shown.

A study of international meteorological reports, conducted with a due regard for the facts referred to, would be calculated to lead to a determination of the relation between changes and movements in the smaller and the greater barometric areas with some cause that is external to the earth's atmosphere. It is possible, also, that study carried along these lines would lead to the discovery that periods of unseasonable weather in any part of the Northern Hemisphere are preceded days, and perhaps weeks, by certain changes in the hemispherical system of barometric pressure, and that all the changes and conditions that are observed in our atmosphere and all kinds and types of weather that we experience are subject to definable laws of causation.

THE PHYSICAL EFFECT ON ANIMAL LIFE OF CHANGES IN ATMOSPHERIC PRESSURE.

As the normal pressure, or weight, of the atmosphere is about 1 ton to every square foot of surface at the level of the sea, and a change of 1 inch in the mercurial column of the barometer means a change in pressure of about 70 pounds to every square foot of surface, decided changes in atmospheric pressure must exert a marked influence upon the body and its functions. A change in the barometer of 1 inch in twenty-four hours is not uncommon in many parts of the United States, and this change in the barometer causes a change of about one-half ton in the weight of the atmosphere that is sustained by the average human body. It is not difficult, therefore, to imagine that the physical organism of animals may be sensitive to these changes, and that it has become an inherited instinct to associate the sensations experienced under different atmospheric pressures with the kinds of weather they indicate. The organization of diseased and delicate human bodies, and of many kinds of animals is extremely sensitive to atmospheric changes, and aches, pains, and nervousness in humans, and restless behavior on the part of animals, birds, and insects may, in a measure, be attributed to low, rapidly decreasing atmospheric pressure that precedes and attends storm periods.

Birds fly high when the barometer is high and fly low when the barometer is low. The explanation of this fact is that when the barometer is high the air is heavier and denser and has more sustaining capacity, and birds are therefore able to fly or soar high with less effort than would be required at times when the barometer is low and the air less dense.

Everything is lovely and the goose honks high.

Wild geese fly high in pleasant weather and low in bad weather.

The low flight of rooks indicates rain.

When the cuckoo is heard in low lands, it indicates rain; when on high lands, fair weather.

When swallows in evenings fly high and chirp, fair weather follows; when low, rain follows.

When swallows fleet soar high and sport in air,
He told us that the welkin would be clear.

—*Gay.*

Cranes soaring aloft and quietly in the air foreshows fair weather, but if they make much noise, as if consulting which way to go, it foreshadows a storm that's near at hand.—*Thomas Willsford.*

Martins fly low before and during rainy weather.—*Colonel Dunwoody.*

When men-of-war hawks fly high, it is a sign of a clear sky; when they fly low, prepare for a blow.

Bees will not swarm before a near storm.

When bees remain in their hives or fly but a short distance, expect rain.

Smoke falls to the ground preceding rain.

Men work better, eat more, and sleep sounder when the barometer is high.

Do business with men when the wind is from the westerly; for then the barometer is high.

TEMPERATURE.

During the warmer months the temperature generally rises, with falling barometer, before rain, and falls, with rising barometer, after rain begins. During the colder months the temperature usually rises and continues above the normal, before and during rain or snow, and begins to fall, with rising barometer, about the time the rain or snow ends. The rainy periods of summer are cool and the rain or snow periods of winter are warm for the season.

Charts XIV to XXI show for the several seasons the wind directions that attend periods of abnormally high and low temperature in the United States. In the interior of the country periods of high temperature are naturally associated with southerly and southwesterly winds, and periods of low temperature with westerly and northwesterly winds. The charts of wind directions referred to show that on the Atlantic, Pacific, and Gulf coasts, and on the Great Lakes, the water temperature modifies the heat of summer and the cold of winter when on-shore winds prevail.

The changes in temperature before, during, and after storms also have an effect on animal and plant life, and many proverbs are based upon observations of these effects. As, however, changes, in temperature are direct results of wind directions, sayings regarding temperature are almost invariably associated with those relating to the wind.

The warmth of the south wind is enervating.

The cold of the north wind is bracing.

The chill of the east wind is conducive to aches and pa.

The prevailing west winds and moderate temperatures impart the dominating qualities that are possessed by the peoples of the temperate zone.

In the summer, when the sun burns more than usual, expect thunderstorms.

If the temperature increases between 9 p. m. and midnight, when the sky is cloudless, expect rain; and if, during a long and severe period of low temperature, the temperature increases between midnight and morning, expect a thaw.—*C. L. Prince.*

HUMIDITY.

The temperature of the air increases before rain, the capacity of the air for moisture increases with increasing temperature, and the rain winds of the United States are from the oceans and the Gulf. It follows, therefore, that there is an increase in the humidity of the air before rain. It does not follow, however, that every increase in humidity at the earth's surface indicates rain, for in the coast districts an increase in humidity may result from a shift of the wind that causes it to blow temporarily from over the water, and a temporary increase is sometimes due to fog, and neither of these conditions necessarily indicates rain. Ignoring purely local and temporary causes and conditions, however, it may be assumed that, as a rule, general rains are preceded twelve to twenty-four hours by an increase in atmospheric moisture.

The presence in the air of varying amounts of moisture is indicated by the quality that various substances possess to absorb moisture, and by the effect of increasing and decreasing amounts of air moisture on animal and plant life and on many inanimate objects. It is also probable that the moisture of the air shares with atmospheric pressure and temperature in producing good and ill effects on animal and plant life. Warm, moist air attends falling and low barometer, and under these conditions there is feeling of physical and mental lassitude that is in striking contrast to the feeling of exhilaration that accompanies the cool, dry winds that attend rising and high barometer.

Observations to determine the amount and relative amount of atmospheric moisture are usually made with wet and dry bulb thermometers. The wet-bulb thermometer is moistened and the evaporation of the moisture from the bulb cools its surface. When the air is saturated with moisture no evaporation takes place, the air about the instrument will contain no more moisture, and the relative humidity is 100 per cent. The drier the air the more rapid will be the process of evaporation and the greater will be the difference between the readings of the wet and dry bulb thermometers. Hygrometers are constructed which depend for a record upon the effect of moisture on hair that has been specially prepared for this purpose; these devices do not, however, possess a sufficient degree of accuracy to meet the needs of scientific work. Neither do twice-daily readings of the dry and wet bulb thermometers afford sufficient data for a satisfactory study of the relation between atmospheric moisture and rainfall, and until some

means can be devised and utilized for securing continuous records of atmospheric moisture for comparison with similar records of atmospheric pressure and temperature this important factor in the production of precipitation and frost can not be properly utilized in the work of weather forecasting.

The following proverbs are based upon the effects of atmospheric moisture that have been observed preceding rain:

Rain comes from a mass of vapor which is cooled.—*Aristotle.*

Mountains cool the uplifted vapor, converting it again into water.—*Aristotle.*

A red sun has water in his eye.

The greater the difference between the readings of the wet and dry bulb thermometers the greater will be the probability of fine weather, and vice versa.—*C. L. Prince.*

When walls are unusually damp rain is expected.

Horses sweating in the stable is a sign of rain.

Doors and windows are hard to shut in damp weather.

Flies sting and are more troublesome than usual when the humidity increases before rain.

Sailors note the tightening of the cordage on ships as a sign of coming rain.

Sensitive plants contract their leaves and blossoms when the humidity increases.

A piece of seaweed hung up will become damp previous to rain.

A lump of hemp acts as a good hygrometer and prognosticates rain when it is damp.

Tobacco becomes moist preceding rain.

When rheumatic people complain of more than ordinary pains it will probably rain.

When the locks turn damp in the scalp house surely it will rain.—*American Indians.*

If corns, wounds, and sores itch or ache more than usual rain is likely to fall shortly.

When matting on the floor is shrinking, dry weather may be expected. When matting expands, expect wet weather.

Ropes shorten with an increase of humidity.

Ropes being difficult to untwist indicate rain.

Quarries of stone and slate indicate rain by a moist exudation from the stones

Salt increases in weight before rain.

A farmer's wife says when her cheese salt is soft it will rain; when getting dry fair weather may be expected.

If metal plates and dishes sweat it is a sign of bad weather.—*Pliny.*

Three foggy or misty mornings indicate rain. (Oregon.)

A rising fog indicates fair weather; if the fog settles down expect rain.

Fog from seaward, fair weather; fog from landward, rain. (New England.)

Hoar frost indicates rain.

Heavy frosts bring heavy rain; no frosts, no rain. (California.)

The larger the halo about the moon the nearer the rain clouds and the sooner the rain may be expected.

When the perfume of flowers is unusually perceptible rain may be expected.

When the mountain moss is soft and limpid expect rain. When mountain moss is dry and brittle expect clear weather.

Sunflower raising its head indicates rain.

Rainbow in morning, shepherds take warning;
Rainbow at night, shepherds' delight.

Rainbow at night, sailors' delight;
Rainbow in morning, sailors' warning.

Rainbow in morning shows that shower is west of us and that we will probably get it. Rainbow in the evening shows that shower is east of us and is passing off.

Snakes expose themselves on the approach of rain.

In dry weather, when creeks and springs that have gone dry become moist, or, as we may say, begin to sweat, it indicates approaching rain. Many springs that have gone dry will give a good flow of water just before rain.—*J. E. Walter, Kansas.*

Drains, ditches, and dunghills are more offensive before rain.

Floors saturated with oil become very damp just before rain.

Guitar strings shorten before rain.

Human hair (red) curls and kinks at the approach of a storm, and restraightens after the storm.

Lamp wicks crackle, candles burn dim, soot falls down, smoke descends, walls and pavements are damp, and disagreeable odors arise from ditches and gutters before rain.

Pipes for smoking tobacco become indicative of the state of the air. When the scent is longer retained than usual and seems denser and more powerful it often forebodes a storm.

Soap covered with moisture indicates bad weather.

Refractions of light of any remarkable kind frequently forebode rain, sometimes storms; at sea the knowledge of this is very useful. Circles around the sun and moon, mock suns, and other phenomena of this kind, together with the unusual elevation of distant coasts, masts of ships, etc., particularly when the refracted images are inverted, are known to be frequent foreboders of stormy weather.

ANIMALS.

The observations of naturalists, shepherds, herdsmen, and others who have been brought much into contact with animals, have proved most clearly that these creatures are cognizant of approaching changes in the state of the air long before we know of their coming by other signs. To many kinds of animals, birds, and insects, the weather is of so much more importance than to us, that it would be wonderful if nature had not provided them with a more keenly prophetic instinct in this respect. The occurrence of a storm would, doubtless, be the means of depriving some of the Carnivora of a meal, and it is known that utter destruction would occur to the nests of some birds if the tenents were absent during a gale of wind or a pelting shower; while to vast numbers of insects the state of the weather for the fraction of a week may determine the whole time during which they may enjoy their little lives. To enable all these creatures to prepare for coming trouble, they seem to have been fitted with what is to us an unknown sense informing them of minute changes in the atmosphere, and it has long been observed that they eat with more avidity, return to their homes, or become unusually restless before the coming of the danger of which they are forwarned.—*Weather Lore.*

Cats have the reputation of being weather wise, an old notion which has given rise to a most extensive folklore. It is almost universally believed that good weather may be expected when the cat washes herself, but bad when she licks her coat against the grain, or washes her face over her ears, or sits with her tail to the fire.

When cattle go out to pasture and lie down early in the day it indicates early rain.

Dogs making holes in the ground, eating grass in the morning, or refusing meat are said to indicate coming rain.—*Colonel Dunwoody.*

All shepherds agree in saying that before a storm comes sheep become frisky, leap, and butt or "box" each other.—*Folklore Journal.*

When horses and cattle stretch out their necks and sniff the air it will rain.

Horses, as well as other domestic animals, foretell the coming of rain by starting more than ordinary and appearing in other respects restless and uneasy.

Hogs crying and running unquietly up and down with hay or litter in their mouths foreshadow a storm to be near at hand.—*Thomas Willsford.*

Kine, when they assemble at one end of a field with their tails to windward, often indicate rain or wind.

When oxen or sheep collect together as if they were seeking shelter a storm may be expected.—*Apache Indians.*

BIRDS.

When birds of long flight hang about home expect a storm.

Migratory birds fly south from cold and north from warm weather. When a severe cyclone is near, they become puzzled and fly in circles, dart in the air, and can be easily decoyed. (North Carolina.)

When birds cease to sing, rain and thunder will probably occur.

Birds and fowls oiling feathers indicate rain.

If fowls roll in the dust and sand, rain is at hand.

Bats flying late in the evening indicate fair weather. Bats who speak flying tell of rain to-morrow.

If cocks crow late and early, clapping their wings occasionally, rain is expected.

If the cock goes crowing to bed,
He'll certainly rise with a watery head.

Chickens, when they pick up small stones and pebbles, and are more noisy than usual, afford, according to Aratus, a sign of rain. Other authors prognosticate the coming of rain from the habit fowls have of rubbing in the dust and clapping their wings.

When chimney swallows circle and call, they speak of rain. (Zuni Indians.)

When cranes make a great noise or scream, expect rain.

One crow flying alone is a sign of foul weather, but if crows fly in pairs expect fine weather.

If the wild geese gang out to sea,
Good weather there will surely be.

If crows make much noise and fly round and round, expect rain.

Wild geese flying past large bodies of water indicate change of weather. Going south, cold; going north, warm.

Guinea fowls squall more than usual before rain.

Clamorous as a parrot against rain.—*Shakespeare.*

Parrots whistling indicate rain.

Gulls will soar aloft, and, circling around, utter shrill cries before a storm.

When grouse drum at night, Indians predict a deep fall of snow.

When the peacock loudly bawls,
Soon we'll have both rain and squalls.

When herons fly up and down as in doubt where to rest, expect rain.

Martins fly low before and during rain.

When the voices of blackbirds are unusually shrill, or when blackbirds sing much in the morning, rain will follow.

Pigeons return home unusually early before rain.

If sea fowls retire to the shore or marshes, a storm is approaching.

Loud and long singing of robins denotes rain.

Robins will perch on the topmost branches of trees and whistle when a storm is approaching.

The stormy petrel is found to be a sure token of stormy weather. When these birds gather in numbers in the wake of a ship, the sailors feel sure of an impending tempest.

FISH.

When fish bite readily and swim near the surface, rain may be expected.

Fishes in general, both in salt and fresh waters, are observed to sport most and bite more eagerly before rain than at any other time.

Black-fish in schools indicate an approaching gale.

Air bubbles over clam beds indicate rain.

When pike lie on the bed of a stream quietly, expect rain or wind.

Porpoises, when they sport about ships and chase one another as if in play, and indeed their being numerous on the surface of the sea at any time, is rather a stormy sign. The same may be said of dolphins and grampus. That the cause of these motions is some electrical change in the air seems probable. Wilsford, in his Secrets of Nature, tells us, "Porpoises or sea-hogs, when observed to sport and chase one another about ships, expect then some stormy weather."

Trout jump and herring schools more rapidly before rain.

The appearance of a great number of fish on the west coast of the Gulf of Mexico indicates bad weather and easterly winds.

INSECTS.

A bee was never caught in a shower.

When bees to distance wing their flight,
Days are warm and skies are bright;
But when their flight ends near at home,
Stormy weather is sure to come.

When ants are situated on low ground, their migration may be taken as an indication of approaching heavy rains.

Expect stormy weather when ants travel in lines, and fair weather when they scatter.

Ants are very busy, gnats bite, crickets are lively, spiders come out of their nests, and flies gather in houses just before rain.

If spiders are indolent, rain generally soon follows. Their activity during rain is proof of its short duration.

When flies congregate in swarms, rain follows soon.

When flies bite greedily, expect rain.

Spiders strengthening their webs indicates rain.

If garden spiders forsake their cobwebs, rain is at hand.

When you see the ground covered with spider webs which are wet with dew, and there is no dew on the ground, it is a sign of rain before night, for the spiders are putting up umbrellas; but others say when the spiders put out their sunshades it will be a hot day.

PLANTS.

The odor of flowers is more apparent just before a shower (when the air is moist) than at any other time.

Cottonwood and quaking asp trees turn up their leaves before rain.

When the leaves of the sugar maple tree are turned upside down, expect rain.

The convolvulus folds up its petals at the approach of rain.

Before rain the leaves of the lime, sycamore, plane, and poplar trees show a great deal more of their under surface when trembling in the wind.

Clover leaves turned up so as to show light under side indicate approaching rain.

Corn fodder dry and crisp indicates fair weather; but damp and limp, rain. It is very sensitive to hygrometric changes.

When the pink-eyed pimpernel closes in the daytime, it is a sign of rain.

Milkweed closing at night indicates rain.

Mushrooms and toadstools are numerous before rain.

The pitcher plant opens its mouth before rain.

Trees grow dark before a storm.

When the leaves of trees curl, with the wind from the south, it indicates rain.

SUN.

The sun, moon, and stars indicate impending weather changes only so far as their appearance is affected by existing atmospheric conditions.

> The sun reveals the secrets of the sky,
> And who dares give the source of light the lie.
>
> *Virgil.*

> The sun sets weeping in the lowly west,
> Witnessing storms to come, woe, and unrest.
>
> *Shakespeare.*

When the sun sets unhappily (with a hazy veiled face), then will the morning be angry with wind, storm, and sand. (Zuñi Indians.)

> Above the rest, the sun who never lies,
> Foretells the change of weather in the skies;
> For if he rise unwilling to his race,
> Clouds on his brow and spots upon his face,
> Or if through mists he shoot his sullen beams,
> Frugal of light in loose and straggling streams,
> Suspect a drizzling day and southern rain,
> Fatal to fruits, and flocks, and promised grain.
>
> *Virgil.*

Since the colors and duration of twilight, especially at evening, depend upon the amount of condensed vapor which the atmosphere contains, these appearances should afford some indications of the weather which may be expected to succeed. The following are some of the rules which are relied upon by seamen: When after sunset the western sky is of a whitish yellow, and this tint extends a great height, it is probable that it will rain during the night or next day. Gaudy or unusual hues, with hard, definitely outlined clouds, foretell rain and probable wind. If the sun before setting appears diffuse and of a brilliant white, it foretells storm. If it sets in a sky slightly purple, the atmosphere near the zenith being of a bright blue, we may rely upon fine weather.—*Weather Proverbs.*

If the sun sets in dark, heavy clouds, expect rain next day.

A red morn, that ever yet betokened
Wreck to the seamen, tempest to the field,
Sorrow to shepherds, woe unto the birds,
Gust and foul flaws to herdmen and herds.

Shakespeare.

When the sun sets bright and clear,
An easterly wind you need not fear.

When the sun draws water, rain follows soon.

Sun drawing water indicates rain.

If the sun draws water in the morning it will rain before night.

The sun setting after a fine day behind a heavy bank of clouds, with a falling barometer, is generally indicative of rain or snow, according to the season, either in the night or next morning.—*Jenyns.*

When it is evening ye say it will be fair weather: for the sky is red. And in the morning, it will be foul weather today: for the sky is red and lowring.—*Matthew xvi, 2, 3.*

An evening grey and a morning red
Will send the shepherd wet to bed.

Evening red and morning gray,
Two sure signs of one fine day.

Red skies in the evening precede fine to-morrows.

When the sun in the morning is breaking through the clouds and scorching, a thunderstorm follows in the afternoon.

A blur or haziness about the sun indicates a storm.

A solar halo indicates bad weather.

Next mark the features of the God of Day;
Most certain signs to mortals they convey,
When fresh he breaks the portals of the east,
And when his wearied coursers sink to rest.
If bright he rise, from speck and tarnish clear,
Throughout the day no rain or tempest fear.
If cloudless his full orb descend at night,
To-morrow's sun will rise and shine as bright.
But if returning to the eastern sky,
A hollow blackness on his center lie;
Or north and south his lengthened beams extend,
These signs a stormy wind or rain portend.
Observe if shorn of circling rays his head,
And o'er his face a veil of redness spread;
Far o'er the plains the God of Winds will sweep,
Lashing the troubled bosom of the deep.
If in a shroud of blackness he appear,
Forewarned, take heed—a drenching rain is near
If black and red their tints together blend,
And to his face a murky purple lend,
Soon will the wolfish wind tempestuous howl,
And the big clouds along the welkin roll.
And foul weather expect, when thou canst trace
A baleful halo circling Phœbus' face
Of murky darkness, and approaching near:
If of two circles, fouler weather fear.

Mark when from eastern wave his rays emerge,
And ere he quench them in the western surge,
If near th' horizon ruddy clouds arise,
Mocking the solar orb in form and size:
If two such satellites the sun attend,
Soon will tempestuous rain from heaven descend:
If one, and north, the northern wind prevails;
If one, and south, expect the southern gales.

J. Lamb's "Aratus."

MOON.

The moon and the weather
May change together;
But change of the moon
Does not change the weather.
If we'd no moon at all,
And that may seem strange,
We still should have weather
That's subject to change.

"Notes and Queries."

The circle of the moon never filled a pond; the circle of the sun wets a shepherd.

If the full moon rises clear, expect fine weather.

A lunar halo indicates rain, and the larger the halo the sooner the rain may be expected.

Last night the moon had a golden ring,
But to-night no moon I see.
If the moon show a silver shield,
Be not afraid to reap your field;
But if she rises halved round,
Soon will tread on deluged ground.

A large ring around the moon and low clouds indicate rain in twenty-four hours; a small ring and high clouds, rain in several days.

The moon with a circle brings water in her beak.

The moon, if in house be, cloud it will, rain soon will come. (Zuñi Indians.)

If the full moon rise pale, expect rain.

When the moon rises red and appears large, with clouds, expect rain in twelve hours.

Therefore the moon, the governor of the floods,
Pale in her anger, washes all the air
That rheumatic diseases do abound.

Shakespeare.

The moon, her face if red be,
Of water speaks she. (Zuñi Indians.)

When the moon is darkest near the horizon, expect rain.

Each sign observe—more sure when two agree;
Nor doubt the event foretold by omens three.
Note well the events of the preceding year,
And with the rising and setting stars compare.
But chiefly look to Cynthia's varying face;
There surest signs of coming weather trace.
Observe when twice four days she veils her light,
Nor cheers with silvery ray the dreary night.
Mark these prognostics through the circling year,
And wisely for the rain, the wind, the storm prepare:

A halo oft fair Cynthia's face surrounds,
With single, double, or with triple bounds;
If with one ring and broken it appear,
Sailors, beware! the driving gale is near.
Unbroken if it vanisheth away—
Serene the air, and smooth the tranquil sea.
The double halo boisterous weather brings,
And furious tempests follow triple rings.
These signs from Cynthia's varying orb arise—
Forewarn the prudent, and direct the wise.

J. Lamb's "Aratus."

STARS.

When the stars flicker in a dark background, rain or snow follows soon.

When the stars begin to huddle,
The earth will soon become a puddle.

Before the rising of a wind the lesser stars are not visible, even on a clear night.—*Pliny, XVIII, 80.*

When the sky seems very full of stars, expect rain, or, in winter, frost.

Excessive twinkling of stars indicates heavy dews, rain, or snow, or stormy weather in the near future.

When the stars above 45° in altitude, or the North Star, flickers strangely, or appears closer than usual, expect rain.

When the stars appear to be numerous, very large, and dull, and do not twinkle, expect rain.

Now mark where high upon the zodiac line
The stars of lustre-lacking Cancer shine.
Near to the constellation's southern bound
Phatne, a nebulous bright spot, is found.
On either side this cloud, nor distant far,
Glitters to north and south a little star.
Though not conspicuous, yet these two are famed—
The Onoi by ancient sages named.
If when the sky around be bright and clear,
Sudden from sight the Phatne disappear,
And the two Onoi north and south are seen
Ready to meet—no obstacle between—
The welkin soon will blacken with rain,
And torrents rush along the thirsty plain.
If black the Phatne, and the Onoi clear,
Sure sign again that drenching showers are near.
And if the northern star be lost to sight,
While still the southern glitters fair and bright,
Notus will blow. But if the southern fail,
And clear the northern, Boreas will prevail.
And as the skies above, the waves below
Signs of the rising wind and tempest show.

J. Lamb's "Aratus."

When the bright gems that night's black vault adorn
But faintly shine—of half their radiance shorn—
And not by cloud obscured or dimmed to sight
By the fine silvery veil of Cynthia's light,
But of themselves appear to faint away,
They warning give of a tempestuous day.

J. Lamb's "Aratus.

LONG-RANGE WEATHER FORECASTS.

In the early ages when the classes and the masses of the leading nations of the earth were deficient in educational qualifications even to the extent of ordinary clerical accomplishments, the human mind was particularly receptive to assumptions on the part of so-called sages and wise men of a knowledge of coming events. In later days semi-civilized and barbarous peoples have given credence to the prophesies of their priests and medicine men, and to-day fakirs and clarlatans in the various professional and scientific fields, astrologers, fortune-tellers, and long-range weather forecasters command, in civilized communities, a lucrative following.

Long-range weather forecasts have ever been impossible of achievement. The period for which weather changes and conditions can be forecast varies from two to three days, depending necessarily, in each instance, on the season of the year and existing atmospheric conditions.

Several methods are employed in the compilation of so-called long-range weather forecasts. The first method, and the only one that possesses merit, being a statement based upon average weather conditions that have prevailed at certain times and seasons in given localities or sections. The main, and fatal, weakness in this system is that average weather conditions are seldom experienced. Average weather conditions are made up largely of extremes, and the probability of experiencing average weather lessens as the length of the period lessens. The average weather for a year differs but slightly from the normal of many years. The seasons possess each year the same general characteristics as regards temperature, precipitation, and winds. The months exhibit, year after year, the same general type of weather. For periods of less than a month, however, averages possess but little value in weather forecasting, and attempts to specify in detail the weather conditions for weeks, months, or seasons in advance are, for all practical purpose, valueless.

Long-range weather forecasts based upon astronomical events, or upon the appearance of the heavenly bodies, can not stand the test of verification, and careful examinations and comparisons have failed to establish any connection between the movements, positions, and changes of the sun, moon, and stars with changes in the weather that are experienced from day to day. Neither can it be shown that the actions of animals, birds, and fish, or the condition of plant life, give evidence of other than present or past weather conditions; and long-range weather forecasts based upon the condition of the weather on certain days have for a basis superstition and ignorance.

It will be interesting, however, to quote and discuss, under the several heads, proverbs, or sayings, that embody long-range forecasts that have been handed down, in many instances, through centuries of

time. As all weather sayings relating to the sun apply more particularly to the character of the weather as regards sunshine, on specified calendar and church days, a reference will be made to sayings of this class under the heading, "Days, months, seasons, and years."

SUN SPOTS.

A favorite theory among meteorologists is that sun spots have a definite influence upon meteorological as well as upon magnetic and electrical conditions, and that the more or less well-defined eleven-year period of sun-spot maximum can be directly associated with rainfall and the distribution of temperature and barometric pressure.

Prof. F. H. Bigelow, of the United States Weather Bureau, has recently written as follows regarding the relation between sun spots and terrestrial phenomena:

> The variation in the solar output, as registered in the relative frequency of solar spots, has long been known to have a marked synchronism with the horizontal component of terrestrial magnetism. The sun spots constitute but a sluggish register of the solar activity, and the curve of terrestrial magnetic force presents a series of characteristic miner fluctuations superimposed on the general eleven-year curve. These special variations reappear with marked distinctness in the frequency of the solar prominences; and they are coordinate with the variations of themean annual barometric pressures all over the earth. The pressures in the earth's atmosphere are undergoing changes in short cycles of about three years in duration, which correspond with changes in the external work of the sun, and the cycles are produced by the modifications in the general circulation of the atmosphere. There is, besides, a sort of surging of the atmosphere with more or less stationary configurations, and these involve the seasonal climatic changes of weather by which one year differs from another. Thus the regions about the Indian Ocean and South America vary synchronously, but inversely; the continental and ocean areas do the same. There seems to be a tendency toward a greater cyclic change with a period of about eight years, within which the pressure excesses begin, for example, in India, pass through Asia, Europe, North America, and South America back to India. This synchronism between solar and terrestrial variations holds, in the United States, for the pressures, temperatures, storm-track movements in longitude and latitude, cold-wave tracks, etc.

Commenting upon this summary, the New York Sun of April 26, 1903, remarks:

> Meteorology has a deep interest in elucidating these fundamental relations of solar and terrestrial physics, since upon this depends our hope of making seasonal forecasts upon a scientific basis.

In a recent article Sir Joseph Norman Lockyer remarks regarding this subject, as follows:

> Everybody agrees that all the energy utilized on this planet of ours, with the single exception of that supplied by the tides, comes from the sun. We are all familiar with the changes due to the earth's daily rotation bringing us now on the side of our planet illumined by the sun, then plunging us into darkness; that changes of season must necessarily follow from the earth's yearly journey around the sun is universally recognized.

On the other hand, it is a modern idea that these solar phenomena which prove to us considerable changes of temperature in the sun itself, may, and indeed should, be echoed by the changes on our planet, giving us thereby an eleven-year period to be considered, as well as a year and a day.

This response of the earth to solar changes was first observed in the continuous record of those instruments which register for us the earth's magnetism at any one place. The magnetic effects were strongest when there were more spots, taking them as indicators of solar changes. Lamont first (without knowing it) made this out at the beginning of the latter half of the century (1851) from the Göttingen observations of the daily range of the declination needle. Sabine the next year not only announced the same cycle in the violence of the "magnetic storms" observed at Toronto, but at once attributed them to solar influence, the two cycles running concurrently. It is now universally recognized that terrestrial magnetic effects, including auroræ, minutely echo the solar changes.

The eleven-year period is not one to be neglected. Next comes the inquiry in relation to meteorology. Sir William Herschel, in the first year of the nineteenth century, when there were practically neither sun-spot nor rainfall observations available, did not hesitate to attack the question whether the price of wheat was affected by the many or few spot solar condition. He found the price to be high when the sun was spotless, and vice versa.

By 1872, however, we had both rainfall and sun-spot observations, and the cycle of the latter had been made out. Meldrum, the most distinguished meteorologist living at the time, and others, pronounced that the rainfall was greatest at sun-spot maximum, and, further, that the greatest number of cyclones occurred in the East and West Indies at the same time.

This result with regard to rainfall was not generally accepted, but Chambers showed shortly afterwards an undoubted connection between the cycles of solar spots and barometric pressure in the Indian area. An attempt has been recently made to study the temperature history of the sun since 1877, and the years of mean temperature, and when the heat was in excess and defect.

In the year 1900 Camille Flammarion, the French scientist, observed the great sun spots, including the one discovered by Abbé Mareux, and predicted that the earth was about to enter upon a period of five years, the summers of which would be the hottest in its history. Continuing a discussion of the relation between sun spots and weather, the Chicago Chronicle of July 28, 1901, states as follows:

Camille Flammarion bids fair to make good his prophecy. Yet even now meteorologists and astronomers refuse to believe that he has established any direct connection between terrestrial weather and spots on the sun. Such a connection has for a long time been suspected, but nothing definite in the way of a law has been discovered.

That we shall soon be in a position to forecast the seasons by means of a study of the chemical or physical condition of the sun seems likely. The sun, far from being a great star of unvarying physical characteristics, varies very materially and is very much hotter and brighter at certain periods than it is at others. Its probable temperature at its normal state is about 12,632° F., or 7,000° C., but its radiation of heat year by year is not even, so that in certain years the earth receives much more heat than it does in others, and in consequence important meteorologic changes are set up, the precise nature of which science seems to be just on the edge of unraveling.

For instance, the British astronomer Sir Norman Lockyer has just announced his conclusion that the seasonal rainfall and great heats in India follow certain changes

in the sun, and that the famines of India, which bring such unspeakable misery and woe to the teeming millions of this unfortunate country, can be forecast from known solar changes. But as the weather of India is not an isolated phenomenon, but is interlocked with that of Africa and this in turn with that of the Western Hemisphere, a weather cycle in one country is unquestionably duplicated in others.

At present, however, no one has worked out the data for the north temperate zone sufficiently to discover what this cyclical change in our weather is that follows the variation of the physical state of the sun. Sir Norman, however, believes we shall get at the law of change before long and will be able to forecast weather over long periods by a study of the sun's surface. For instance, a huge sun spot was observed in the sun recently which was of such magnitude as to cause much surprise among astronomers, since the sun is now at a period when the sun spots are the least frequent. Conditions are, however, shaping themselves for a period of numerous sun spots in 1904, of which the huge spot observed this spring is the forerunner.

Those who are inclined to jump at conclusions connect the abnormal summer of 1900 with the big spot seen during that summer, while the recent hot wave is blamed on the big spot of June, 1901. And they recall the successful forecast of Abbe Mareux, who, basing his views on the sun-spot activities of the spring of 1900, predicted a hot summer. But the scientific world is not convinced that the data show that the hotter sun is followed by hotter terrestrial weather, though it is convinced that there is a law connecting solar changes with weather changes in the earth, even though it is marked in its operation.

Sir Norman in the case of India has found that the famine years precede the period when the sun is normal, while the seasonable rainfall that relieves the drought follows this normal period invariably. If anything retards the return to the normal period, which has been the case from the year 1897 on, the drought and famine periods are prolonged.

Following up this discovery, which is connected with the eleven-year period in sun-spot variation, W. J. S. Lockyer has made another and exceedingly important discovery, that underlying the ordinary sun-spot period of eleven years there is another cycle of greater length, namely, about thirty-five years, and that this cycle not only alters the time of the occurrence of the period of least frequency, but also causes changes in the total spotted area of the sun from one eleven-year period to another. As it is known that the presence of sun spots does affect the frequency of the aurora borealis and the magnetic phenomena on the earth, great sun spots being followed by magnetic storms that disturb telegraph and telephone systems the world over, Mr. Lockyer has found there is a thirty-five year period in magnetic phenomena, as he puts it:

"There seems little doubt that during the interval of time covered by the present sun-spot discussion the meteorological phenomena, number of auroræ, and magnetic storms show secular variations of a period of about thirty-five years, the epochs of which harmonize with those of the secular variations of sun spots. As we are beginning to approach another maximum of sun spots which should correspond both in intensity and in time of occurrence after the epoch of the present minimum with that of 1870–1878, it will be interesting to observe whether all the solar, meteorological, and magnetical phenomena of that period will be repeated.

"If there is a more or less exact repetition of meteorological phenomena with the return of the thirty-five year period, then the summer of 1901 should be somewhat like the summer of 1867 and the summers of 1902, 1903, 1904 like those of 1868, 1869, and 1870. If this be so, we are not in for a hot summer (in 1901), as absurd as this may seem in view of the record-breaking character of July, but for a series of cool summers. For, according to the Pennsylvania Hospital records, there were only six days during June, July, August, and September, 1867, when the thermometer ran above 90°, while 1868 for the same months only recorded twelve days above 90°;

1869, fourteen, and 1870, thirty-three days, with the highest temperature only 98°. Moreover, June, 1867, had a rainfall of 11.03 inches, while last June, 1901, had only 1.15 inches to its credit."

From this it would appear that however the thirty-five year cycle may apply for great areas of the earth's surface in the matter of climate variation, Philadelphia hardly reveals it in its recent brand of weather. And yet weather ought to follow general changes, for those who believe the variation in the sun's physical stresses affect the weather are agreed generally that it does it by changes in what are known as the areas of high barometer that belt the globe in the Tropics over the oceans in the summer time.

If this theory be correct, our summer weather ought to be determined by the effect of the sun spots on the oceanic high-pressure areas. And the way in which variations in these high-pressure areas affect our weather can be seen by glancing at the United States hydrographic chart, which shows the normal barometric pressure in inches, as well as the normal temperature lines and the resulting circulation of winds. If the Atlantic high-pressure area is shifted toward the Atlantic coast of the United States, it gives us a circulation that is tropical, and if the pressure continues high over the coast, the whole eastward-moving drift of weather over the continent is held up and a hot wave results, which can not be broken up until the Atlantic pressure is reduced.

The question whether a summer in the United States will be abnormally hot is therefore merely a question as to whether the high pressure over the Atlantic will be shifted toward Bermuda and the Atlantic coast. Of course, such a shift means a shift in the high pressures of the Pacific and Indian oceans, for what affects one great system affects the other, and so the weather all the world around is affected.

That a sun spot should be able to affect terrestrial weather can not be considered remarkable when it is remembered that the spots are evidence of tremendous activities in the sun, being nothing more than huge cyclonic disturbances deep down in the photosphere, often 2,000,000 square miles in area, from whose vortices, in which many earths might float, prominences are whirled miles above the sun's surface. Moreover, the photosphere is more brilliant and hot about the spots than anywhere else on the sun's surface. It has been argued that, inasmuch as the sun spots occupy only an infinitesimal space on the surface of the sun, they are too minute to affect the meteorological results with which they are associated. But Sir Norman Lockyer points out that the greater disturbance of certain zones of solar latitude is more influential than the amount of spotted area determined from spots in various latitudes.

Sun spots may be only millionths of the area, but these prominences form one-sixth of the sun's visible hemisphere, and with these in a state of disturbance the effects upon the earth are very important. The sun spots themselves are only a very feeble indication of the fierce activity of the sun. We are observing those prominences more carefully than we have been able to do in the past. We are taking advantage of new methods of observation, and in a few years we shall be in a much better position than we are now to study the connection of solar and terrestrial meteorology.

As the situation shapes up to-day the scientific world is on the lookout for laws of causation that connect solar changes with the great droughts, great floods, and excessive heat waves that mark our weather at different periods. And it looks as if some clever observer would soon wrest the secret from the sun spots and the vagaries of American summer weather even if none of the suggested periods seem to be revealed in the actual recorded weather data.

It appears, in fact, that while a consensus of opinion of those who have contributed to sun-spot literature is, that solar disturbances, as indicated by sun spots, affect the earth's magnetic and electrical

conditions, a definite relation between sun spots and meteorological conditions has not been established. It is, however, possible and even probable, that longer periods of observation will permit comparisons that may define concurrent cycles in sun spots and weather. The idea that the sun controls not only the character of the weather experienced in the several seasons, but also the ordinary and extraordinary weather changes to which we are subjected from day to day, is a popular one, and discoveries in this direction will be welcomed by the meteorologist and the layman.

THE MOON AND THE WEATHER.

That the moon has a controlling influence in matters meteorological is a fixed belief in the minds of the masses, and evidence to the contrary, in the form of weather records that fail utterly to show any connection between moon changes and the weather, has been, and is likely to be, insufficient to change this belief.

The following remarks, pertinent to this subject, appear in the Baltimore Sun of December 6, 1900:

The eminent astronomer, Sir John Herschel, at one time, from very insufficient data, investigated the subject, and, thinking he had discovered a connection between the moon's changes and the weather, constructed tables based upon the time at which the moon's changes occur before and after noon and midnight. It is, however, greatly to Sir John's credit, that he afterwards thoroughly investigated the subject with a much more complete and extensive series of weather records, and proved conclusively that there is no connection whatever between the moon's changes and the weather, unless it were a slight tendency to clearer skies at night at the time of full moon. The most exhaustive investigations made since then have shown conclusively the correctness of Herschel's later conclusions, except that they discredit any tendency of the full moon to produce clear skies.

There are only three possible ways in which the moon could have any physical connection with the weather or influence it in any way whatever. The first is by reason of the heating effect of the lunar rays upon the earth and its atmosphere. The heating effect of the moon's rays has been measured and found to be less than one hundred-thousandth as much as those of the sun. Such a small amount of heat added to the sun's heat would be absolutely insensible. Another possible way in which it has been thought the moon might influence the weather is by producing atmospheric tides, and, as the ocean tides caused by the moon are greater than those caused by the sun, it was at one time thought that this might be the connection. It has, however, required the most careful investigation to show any atmospheric tides caused by the moon's attraction. A minute effect has been found, but it is too small to be of any importance.

The reason why the moon produces greater oceanic tides than the sun is not that its attraction is greater than that of the sun, for as a matter of fact the sun's attraction on the earth is nearly two hundred times as great as that of the moon, whereas the moon's tide-rising power is about two and one-half times as great as the sun's. This is because the sun is four hundred times as far off, and the difference in the attraction for the body upon the nearest and the farthest side of the earth and for the center of the earth is greater in the case of the moon than the sun, so that on the nearest side, the water being mobile and the body of the earth rigid, the water is

pulled away from the earth, and on the farther side the earth is pulled away from the water to a greater extent by the moon than by the sun.

The only other way in which the moon could possibly influence the weather is by magnetic effects. It does have a measurable effect upon the earth's magnetism, but it has never been shown that variations in the earth's magnetism materially influence the weather, although the variations of the atmospheric electricity is greatly influenced by weather conditions.

The so-called wet or dry moons (and, by the way, there is much difference of opinion as to which is the wet and which is the dry moon), or the inclination of the crescent moon to the horizon, are popularly supposed to indicate the weather for the following month. But this inclination of the crescent to the horizon depends mostly upon the inclination of the ecliptic, an hour or two east of the sun to the horizon, and, to a small extent only, to the latitude of the moon north or south of the ecliptic. The inclination of the ecliptic to the horizon depends upon the time of year, and similar wet or dry moons will always occur about the same time of the year.

According to M. Demtchinski, a Russian engineer and scientist, the attraction of the moon is the chief factor in determining the weather. M. Demtchinski read a paper in September, 1900, before the Meteorological Congress in Paris, "On the possibility of making exact forecasts of the weather for any period in advance." It is said that the data communicated to the congress, supplemented by subsequent results, afford ground for the conviction that the weather may be predicted several years beforehand.

M. Demtchinski has such faith in his theory that he has undertaken the publication at St. Petersburg of a semimonthly journal, Climate, which is printed in four languages, English, French, Russian, and German, and which undertakes to predict the weather over almost the whole northern hemisphere. The first number of Climate appeared March 1, and each number is to be issued sufficiently early to reach the most distant points for which predictions are made before the commencement of the fortnight to which they refer. Thus the Russian forecasts for the first fortnight of May will come out in the beginning of April.

We are assured that the theory has already stood the test of experience. Last year, for example, the day of the morning frosts in May was duly predicted for the Moscow region. In like manner, the eight days' dry period in June was forecast, with the practical suggestion to farmers in central Russia to save their hay. The Russian press for the month of March contained an article by M. Demtchinski giving a forecast of the harvest (spring and winter corn) to be expected in Russia, which was fully borne out by the result. The September frosts and the beginning of the Russian winter were predicted with equal accuracy. Finally, to an inquiry addressed by the Volga shipowners to M. Demtchinski when to expect the closing of navigation, the latter wired in reply, a month beforehand, "Navigation will close the 20th October," which was exactly fulfilled.

The theoretical questions which Climate is to encourage are to be concentrated on the question of the influence of the moon on the weather, and M. Poincaré, a French mathematician and meteorologist, has an article on the subject in the first number. In the estimation of unscientific observers the moon has a great deal to do with the weather, and it is possible that European scientists have discovered the principle upon which it exerts the mysterious influence which every weatherwise rustic has observed from the time when the memory of man runneth not to the contrary.

The following are among oft-quoted sayings regarding the moon that refer to its influence upon weather conditions for considerable periods in advance:

If three days old her face be bright and clear,
No rain or stormy gale the sailors fear;
But if she rise with bright and blushing cheek,
The blustering winds the bending mast will shake.
If dull her face and blunt her horns appear,
On the fourth day a breeze or rain is near.
If on the third she move with horns direct,
Not pointing downward or to heaven erect,
The western wind expect; and drenching rain,
If on the fourth her horns direct remain.
If to the earth her uppor horn she bend,
Cold Boreas from the north his blast will send;
If upward she extend it to the sky,
Loud Notus with his blustering gale is nigh.
When the fourth day around her orb is spread
A circling ring of deep and murky red,
Soon from his cave the God of Storms will rise,
Dashing with foamy waves the lowering skies.
And when fair Cynthia her full orb displays,
Or when unveiled to sight are half her rays,
Then mark the various hues that paint her face,
And thus the fickle weather's changes trace.
If smile her pearly face benign and fair,
Calm and serene will breathe the balmy air;
If with deep blush her maiden cheek be red,
Then boisterous wind the cautious sailors dread;
If sullen blackness hang upon her brow,
From clouds as black will rainy torrents flow.
Not through the month their power these signs extend,
But all their influence with the quarter end.

—*J. Lamb's "Aratus."*

If the new moon, first quarter, full moon, last quarter, occur between—

Summer: 12 and 2 a. m., fair; 2 and 4 a. m., cold and showers; 4 and 6 a. m., rain; 6 and 8 a. m., wind and rain; 8 to 10 a. m., changeable; 10 a. m. to 12 m., frequent showers; 12 to 2 p. m., very rainy; 2 and 4 p. m., changeable; 4 and 6 p. m., fair; 6 and 8 p. m., fair, if wind northwest; 8 and 10 p. m., rainy, if wind south or southwest; 10 to 12 p. m., fair.

Winter: 12 and 2 a. m., frost, unless wind southwest; 2 and 4 a. m., snow and stormy; 4 and 6 a. m., rain; 6 and 8 a. m., stormy; 8 and 10 a. m., cold rain if wind west; 10 and 12 m., cold and high wind; 12 and 2 p. m., snow and rain; 2 and 4 p. m., fair and mild; 4 and 6 p. m., fair; 6 and 8 p. m., fair and frosty if wind northeast or north; 8 and 10 p. m., rain or snow if wind south or southwest; 10 to 12 p. m., fair and frosty.

The above is the table credited to Sir John Herschel. It is claimed, also, that he was not responsible for the table. In any case it is within the power of anyone to test its accuracy as applied to the United States.

If the new moon appear with the points of the crescent turned up the month will be dry. If the points are turned down it will be wet. [Note.—Many sailors believe

in the direct opposite of the above. The belief is explained as follows: First—If the crescent will hold water the month will be dry; if not, it will be wet. Second—If the Indian hunter could hang his powderhorn on the crescent he did so, and stayed at home, because he knew that the woods would be too dry to still hunt. If he could not hang his powderhorn upon the crescent he put it on his shoulder and went hunting, because he knew that the woods would be wet and that he could stalk game noiselessly.]

When the moon lies on her back,
Then the sou'-west wind will crack;
When she rises up and nods,
Then north-easters dry the sod.
Reviewer in Symons' Meteorological Magazine, September, 1867.

When the moon lies on her back,
She sucks the wet into her lap.
Ellesmere.

It is sure to be a dry moon if it lies on its back, so you can hang your hat on its horns.—*Welsh Border.*

It appears from the foregoing that popular interpretations of weather indications furnished by the crescent moon differ, and are, in fact, of an opposite character among different classes of people. It is the privilege, therefore, of any and all interested to fit the forecasts to the position of the moon, and, in instances where the results are not satisfactory, to assume that a reverse position of the crescent would satisfy the requirements of the theory.

Go plant the bean when the moon is light,
And you will find that this is right;
Plant the potatoes when the moon is dark,
And to this line you always hark;
But if you vary from this rule,
You will find you are a fool;
If you always follow this rule to the end,
You will always have money to spend.

There is a belief in the minds of many persons that certain vegetables and plants should be seeded or planted during certain phases of the moon. The fact that moon phases are not considered where the processes of seeding and planting are conducted on a large scale and with the strictest regard to business and economic methods appears to refute this belief.

That moonbeams or rays produce certain chemical results seems certain. It is known that fish and some kinds of meat are injured or spoiled when exposed to the light of the moon. To this fact the saying that hogs should be slaughtered in the dark of the moon undoubtedly owes its origin. In the larger hog and cattle slaughtering plants the carcasses and meat are not exposed to the moon's rays; the saying applies, therefore, to primitive out-of-door methods of slaughtering and hog killing.

There is a negro saying that "Chickens should be picked in the dark of the moon." It is perhaps unnecessary to remark that while this

saying, in common with other misapplied sayings, can not be properly classed as a weather proverb, a conjunction of a dark-of-the-moon period and a dark, cloudy, and rainy night is most favorable to a practical application of the saying.

THE STARS AND THE WEATHER.

There is a kind of weather lore that has been greatly misinterpreted, in many cases, from a failure to recognize its origin. Before the establishment of the calendar and the setting in order of the period months and seasons of the solar year, it was very necessary to determine the approach of each season in order to facilitate farming operations. At the first this could be done only by watching the rising and setting of the constellations. Thus Hesiod says that when the Pleiades rise the harvest begins. Such sayings have been interpreted as indicating the actual benefit of malevolent influence from stars, but seem, in the first instance, to have depended simply on the necessities of the observer. So the piece of weather lore contained in Job, referring to the sweet influences of the Pleiades, depends on nothing more than the indication of the coming season, as shown by the appearance of these stars.—*St. Louis Star, February 24, 1901.*

The Egyptians and Greeks conducted systematic observations in special buildings which might with justice be termed observatories, albeit not supplied, like ours, with means and methods of a high and complicated order. The great pyramid of Cheops has been claimed for such an observatory, and some writers assume that from an opening in its side the learned priests watched the transits of the stars and the rising of the constellations to determine the march of the various seasons suitable for agriculture or for the irrigation of the people's lands.

ANIMALS, BIRDS, ETC.

There is a mistaken belief that some animals possess a faculty that permits them to anticipate the character of the weather for the coming season. The faculty possessed by animals to interpret the signs of coming weather changes is limited to an instinctive appreciation of present atmospheric conditions, which are indicative of certain weather changes for periods of probably one to twelve hours in advance.

It is evident upon consideration that the physical condition of animals, and the thickness of the fur of fur-bearing animals, depends upon the weather of the past and the extent to which it has affected their food supply and general health, rather than upon the weather of the future. And the line of reasoning also applies to plants which are made the subject of future-weather sayings.

Dr. C. C. Abbott showed that the autumnal habits of certain animals that are popularly supposed to be indicative of the character of the coming winter could not be depended upon, although by the majority of people living in the country they were considered as sure indications of what the coming winter would prove to be. Dr. Abbott had kept a careful record, extending over twenty years, regarding the building of winter houses by muskrats, the storing of nuts by squirrels, and other habits of these mammals, and had found that the habits referred to, or their omission, in certain autumns bore no relation to the character of the coming winter.—*Trenton Natural Historical Society meeting, February 13, 1883.*

The following are well-known long-range weather sayings based upon the observed or supposed habits of animals and birds and the appearance and condition of certain plants. It is proper in this connection to again remark that careful investigation has failed to attach a value to sayings of this class:

In early and long winters the beaver cuts his winter supply of wood and prepares his house one month earlier than in mild, late winters.

The beaver begins his preparations for winter when the cold weather sets in; in early winters the cold naturally sets in earlier than in late winters.

Previous to the setting in of winter the mole prepares a sort of basin, forming it in a bed of clay, which will hold about a quart. In this basin a quantity of worms is deposited; and, in order to prevent their escape, they are partly mutilated, but not so much as to kill them. On these worms the moles feed in the winter months. When these basins are few in number the following winter will be mild.—*Gardener's Chronicle.*

The mole, like the beaver, doubtless begins his preparations for the winter when the cold weather sets in; when the cold comes on suddenly and the ground freezes the work of storing worms is interrupted, and the sign is therefore potent only in cases where early spells of cold are followed by comparatively mild winter weather.

Observe which way the hedgehog builds her nest,
To front the north or south, or east or west;
For if 'tis true what common people say,
The wind will blow the quite contrary way.
If by some secret art the hedgehog knows,
So long before, the way in which the winds will blow,
She has an art which many a person lacks
That thinks himself fit to make our almanacks.

—*Poor Robin's Almanack, 1733.*

The hedgehog commonly hath two holes or vents in his den or cave, the one toward the south and the other toward the north; and look which of them he stops, thence will great storms and winds follow.—*Husbandman's Practice.*

The hedgehog undoubtedly stops the windward vent after the wind begins to blow.

If the cat is basking in the sun in February it must go again to the stove in March. (German.)

The average winter shows warm periods in February and cold periods in March.

When bears lay up food in the fall it indicates a cold winter.

If the tracks of bear are seen after the first fall of snow an open mild winter may be expected.

The bear comes out on the 2d of February (Candlemas day), and if he sees his shadow he returns for six weeks.

If on Candlemas day (February 2) it is bright and clear, the ground-hog will stay in his den, thus indicating that more snow and cold are to come; but if it snows or rains he will creep out, as the winter is ended. (German.)

In cold and early winters the chipmunk is very abundant on the south shore of Lake Superior, and are always housed for the winter in October. In short and mild winters they are seen until the 1st of December.

When the flying squirrels sing in midwinter it indicates an early spring.

When the ground squirrel is seen in winter it is a sign that snow is about over.

When squirrels and small animals lay away a larger supply of food than usual it indicates that a long and severe winter will follow.

When squirrrels are scarce in autumn it indicates a cold winter.

The actions of animals, referred to in the sayings quoted, are governed by conditions that exist at the time, and not by a knowledge of future weather conditions.

When birds of passage arrive early in their southern passage severe weather may be looked for soon.

When summer birds take their flight summer goes with them.

Wild geese moving south indicates approaching cold weather; moving north indicates that most of the winter is over.

When wild geese fly to the southeast in the fall, in Kansas, expect a blizzard.

Wild geese flying directly south and very high indicates a very cold winter. When flying low and remaining along the river, in Idaho, they indicate a warm winter. For spring, just the reverse when flying north.

Wild geese flying past large bodies of water indicates change of weather. Going south, cold; going north, warm.

Wild ducks scattered around the lakes near Lake Superior form in large flocks and go south one month earlier in cold or early winters than in mild or pleasant winters.

If cranes appear early in the autumn expect a severe winter.

When the cranes early (in October) fly southward it indicates a cold winter.

The swan builds its nest high before high waters, but low when there will not be unusual rains.

An early appearance of the woodcock indicates the approach of a severe winter.

If crows fly south a severe winter may be expected; if they fly north, the reverse.

When the woodpecker leaves expect a hard winter. When woodpeckers peck low on the trees expect warm weather.

The ivory-billed woodpecker commencing at the bottom end of a tree and going to the top, removing all the outer bark, indicates a hard winter, with deep snow.

Field larks congregating in flocks indicates severe cold.

When wrens are seen in winter expect snow.

When martins appear winter is broken.

No killing frost after martins.

First robins indicate the approach of spring.

If the November goose bone be thick,
So will the winter weather be;
If the November goose bone be thin,
So will the winter weather be.

If the breastbone of a goose is red, or has many red spots, expect a cold and stormy winter; but if only a few spots are visible the winter will be mild.

The whiteness of a goose's breastbone is superstitiously thought to indicate or foreshow the amount of snow during winter.

Birds, like animals, respond to present, rather than to future, weather conditions. Birds of passage begin their southern migration with the first chilling temperatures of autumn, and outtravel the southward advance of the colder weather; and they begin their northern journey when spring temperatures set in at their winter quarters. That their flights are sometimes premature is apparent to close observers.

As regards goose bones, the fact can readily be demonstrated that breastbones of geese, selected with a due regard to time and condition, are contradictory, both as regards their character and the manner of their interpretation.

DAYS, MONTHS, SEASONS, AND YEARS.

Among the first attempts at weather guesses, those concerning the seasons and their probable fitness for agriculture, the breeding of animals, or the navigation of the seas would probably take a prominent place. The weather, during the winter and spring, seems to have been narrowly watched, and the chances of a good harvest, a fat pasture, or a loaded orchard inferred from the experience of previous years, combined with a fair reliance upon fortune. Some of these predictions, though not strengthened by modern observation, are not to be altogether despised or thrown aside. They at least show us what kind of weather our forefathers wished to take place and thought most useful at the times to which they refer. The sayings of French, Scotch, and English agree in many particulars—such, for instance, as those referring to Candlemas day and the early part of February generally. It seems that, according to the notion of our ancestors, this part of the year could not be too cold, and no statistical evidence will ever make our farmers believe that a warm Christmas bodes well for an English harvest, or that a dry year ever did harm to England. Some of these old sayings are also interesting as perhaps indicating the slowly changing climate of England, and it is not unlikely that at some distant date most of the predictions will be found inapplicable. Particular saints' days have been selected as exerting special influence over the weather, and here we are constantly treading on the fringes of the veil of superstition, spread by ignorance over all matters about which but little certain knowledge exists. There are, however, still believers in St. Swithin and St. Valentine as weather prophets; and if their favorites do sometimes fail to bring the expected changes, they have at least no worse guides than those furnished by the Old Moore's and Zadkiel's of modern times.

In considering the weather proverbs regarding certain days, it must be remembered that the new style was first adopted September 2, 1752, eleven days being retrenched from the calendar, i. e., August 22 to September 1, 1752, had no existence in England.—*Weather Lore.*

DAYS.

As the days lengthen,
So the cold strengthens.

As the days begin to shorten,
The heat begins to scorch them.

Fine and unusually warm days during the colder months are called "weather breeders."

If St. Vincent's (January 22) has sunshine,
One hopes much rye and wine.

If St. Paul's (January 25) is bright and clear,
One does hope a good year.

Candlemas Day! Candlemas Day! (February 2)
Half our fire and half our hay.

(That is, we are midway through winter and ought to have half our fuel and hay in stock.)

At Candlemas Day another winter is on its way.

If Candlemas Day be fine and clear,
Corn and fruits will then be dear.

The shepard would rather see the wolf enter his fold on Candlemas Day than the sun.

If Candlemas Day be fair and bright,
Winter will have another flight.

But if Candlemas Day bring clouds and rain,
Winter is gone and won't come again.

On Candlemas Day the bear, badger, or woodchuck comes out to see his shadow at noon; if he does not see it, he remains out; but if he does see it he goes back to his hole for six weeks, and cold weather continues for six weeks longer.

If the ground hog is sunning himself on the 2d of February, he will return for four weeks to his winter quarters.

If a storm on February 2, spring is near; but if that day be bright and clear, the spring will be late.

To St. Valentine the spring is a neighbor.—*French.*

The crocus was dedicated to St. Valentine, and ought to blossom about this time.—*Circle of the Seasons.*

March many weathers rained and blowed,
But March grass never did good.
Fuller.

Dust in March brings grass and foliage.

Snow in March is bad for fruit and grapevine.

March comes in like a lamb and goes out like a lion.

March in January, January in March, I fear.

When March has April weather, April will have March weather.—*French.*

March winds and April showers,
Bring forth May flowers.

St. Patrick's Day (March 17) the warm side of a stone turns up, and the broad-back goose begins to lay.

Is't on St. Joseph's Day (March 19) clear,
So follows a fertile year.

Is't on St. Mary's (March 25) bright and clear,
Fertile is said to be the year.

The flower cardamine, or lady's-smock, with its milk-white flowers, is dedicated to the Virgin Mary, and appears about Lady Day (March 25).

If it thunders on All Fools' Day,
It brings good crops of corn and hay.

Hoar-frost on May 1 indicates a good harvest.

If on the 8th of May it rain,
It fortells a wet harvest, men sain.—*T. Fuller.*

Rain on St. Barnabas's Day (June 11) good for grapes.

Before St. John's Day (June 24) we pray for rain, after that we get it anyhow.

Rain on St. John's Day, damage to nuts.

As the dog days (July 3 to August 11) commence, so they end.

Dog days bright and clear
Indicate a good year;
But when accompanied by rain,
We hope for better times in vain.

In this month is St. Swithin's Day (July 15)
On which, if that it rain, they say
Full forty days after it will
Or more or less some rain distill.—*Poor Robin's Almanack, 1697.*

All the tears that St. Swithin can cry,
St. Barthelemy's dusty mantle wipes dry.—*French.*

Alluding to the wet usually prevalent about the middle of July, the saying is: "St. Mary Magdalene is washing her handkerchief to go to her cousin St. James's fair.—*Folk-Lore Journal.*

St. Margeret's flood is proverbial, and it is considered to be well for the harvest in England. (August 1, old style; August 13, new style.)

St. Barthelemy's (August 24) mantle wipes dry
All the tears that St. Swithin can cry.
If the 24th of August be fair and clear,
Then hope for a prosperous autumn that year.

September 15 is said to be a fine day six years out of seven.

St. Matthew's Day (September 21) makes the days and nights equal.

If St. Michael (September 29) brings many acorns, Christmas will cover the fields with snow.

There is often, about October 18, a spell of fine, dry weather, and this has received the name of St. Luke's little summer.

On the 1st of November (All Saints' Day), if the weather hold clear,
An end of wheat sowing do make for the year.

If All Saints' Day will bring out the winter, St. Martin's Day will bring out Indian summer. (United States.)

If on All Saints' Day the beechnut is dry we shall have a hard winter; but if the nut be wet and not light, we may expect a wet winter.

If it is at Martinmas (November 11) fair, dry, and cold, the cold in winter will not last long.

If the leaves of the trees and grape vines do not fall before Martin's Day, a cold winter may be expected.

Expect St. Martin's summer, halcyon days.—*Shakespeare.*

The fourteen halcyon days then began (December 11)—days in which in the Mediterrean a calm weather was expected, so that the halcyon or hawk could (it was supposed) make its nest on the surface of the sea.—*Virgil.*

A green Christmas makes a fat churchyard.

A green Christmas brings a heavy harvest.

If Christmas finds a bridge, he'll break it; if he finds none, he'll make one.

Wednesday clearing, clear till Sunday.

If on Friday it rain,
'Twill on Sunday again;
If Friday be clear,
Have for Sunday no fear.

When it storms on the first Sunday in the month, it will storm every Sunday during that month.

The character of the weather on holidays and church or saints' days, when the masses of the people have forsaken their usual occupations in favor of out-of-door recreation, or the donning of the best wearing apparel, has naturally been a subject of unusual interest and special

note. And it has followed from this fact that these days have been, to a greater extent than the ordinary working days, a basis for weather speculation. It will be noted that all sayings relating to these days are of value only so far as it may be assumed that normal weather conditions on those days are favorable and abnormal conditions are unfavorable for seasonable weather in the near future. They may be considered as indicating which way the balance of temperature and precipitation tips at that particular season of the year, and the forecasting feature is found in the statement of weather conditions that will be required to adjust the balance.

MONTHS.

The month that comes in good will go out bad.

A favorable January brings us a good year.

January warm, the Lord have mercy!

If grass grows in January, it grows the worse for it all the year.

Always expect a thaw in January.

If there is no snow before January, there will be the more in March and April.

A warm January, a cold May.

There is always one fine week in February.

If February gives much snow,
A fine summer it doth foreshow.

February rain is only good to fill ditches.

Thunder in February or March, poor sugar (maple) year.

Winds in March and rains in April promise great blessings in May.

As it rains in March, so it rains in June.

A dry and cold March never begs its bread.

March flowers make no summer bowers.

March comes in like a lamb and goes out like a lion.

March comes in like a lion, goes out like a lamb.

March in January, January in March, I fear.

March damp and warm will do the farmer much harm.

When March has April weather, April will have March weather.

March winds and April showers bring forth May flowers.

A cold April the barn will fill.

Moist April, clear June.

Till April's dead, change not a thread (of clothing).

Dry May brings nothing.

May damp and cool fills the barns and wine vats.

A hot May makes a fat churchyard.

To be hoped for, like rain in May.

A dry May is followed by a wet June.

Wet May, dry July.

Calm weather in June sets corn in tune.

June damp and warm does not make the farmer poor.

A cold and wet June spoils the rest of the year.

It never clouds up in a June night for rain.

July, God send thee calm and fayre,
That happy harvest we may see.

As July, so the next January.

Ne'er trust a July sky.

Whatever July and August do boil, September can not fry.

As August, so the next February.

When it rains in August it rains honey and wine.

Dry August and warm
Doth harvest no harm.

As September, so the coming March.

A wet September, drought for next summer. (California.)

Heavy September rains bring drought. (United States.)

Much rain in October, much wind in December.

Warm October, cold February.

If October bring heavy frosts and winds, then will January and February be mild.

As the weather in October, so will it be in the next March.

As November, so the following March.

December cold with snow, good for rye.

SEASONS.

A late spring, a great blessing.

Better late spring and bear, than early blossom and blast.

A late spring never deceives.

If the spring is cold and wet, then the autumn will be cold and dry.

A dry spring, rainy summer.

Early thunder, early spring.

Generally a moist and cool summer portends a hard winter.—*Bacon.*

A pleasant autumn and a mild winter will cause the leaves to fall next September.

A hot and dry summer and autumn, especially if the heat and drought extend far into September, portend an open beginning of winter, and cold to succeed toward the latter part of the winter and beginning of spring.—*Bacon.*

Who doffs his coat on a winter's day
Will gladly put it on in May.

There can never be too much rain before midsummer.

If we do not get our Indian summer in October or November, we shall get it in the winter. (United States.)

A late spring is good for corn, but bad for cattle.

A moist autumn, with a mild winter, is followed by a cold and dry spring, retarding vegetation.

After a rainy winter follows a fruitful spring.

A green winter makes a fat churchyard.

An abundant wheat crop does not follow a mild winter.—*Farmer, quoted in "Notes and Queries."*

A severe autumn denotes a windy summer,
A windy winter a rainy spring,
A rainy spring a severe summer,
A severe summer a windy autumn;
So that the air in balance is
Seldom debtor unto itself.

Bacon.

If the spring is wet and cold, the autumn will be hot and dry.

A warm and open winter portends a hot and dry summer.—*Bacon.*

Midsummer rain spoils wine, stock, and grain.

A warm winter and cold summer never brought a good harvest.—*French.*

Winter will not come till the swamps are full. (United States.)

Winter's back breaks about the middle of February.

Winter under water, dearth; under snow, bread.

YEARS.

A bad year comes in swimming.—*French.*

After a wet year a cold one.

Wet and dry years come in triads.

Rainy year, fruit dear.

Frost year, good year. Snow year, good year.

In the year that plums flourish all else fails. (Devonshire.)

Year of radishes, year of health.

A cow year, a sad year; a bull year, a glad year.—*Dutch.*

A year of grass, good for nothing else. (Switzerland.)

Leap year was ne'er a good sheep year. (Scotland.)

A dry summer through the central part of the United States signifies a deficiency in the corn crop, which means that our ham and bacon will cost us more during the following winter. A wet spring in the wheat belt means a higher price for flour. Unseasonable weather in the South signifies that a few months later we shall be obliged to pay more for cotton goods. A frost in Florida means a higher price for oranges.

AN INNOVATION IN BAROMETRIC OBSERVATION.

In the Monthly Weather Review for January, 1903, the Chief of the United States Weather Bureau introduces a new feature. Among the charts hitherto appearing in that publication has been one showing the mean barometric pressure over the whole country for a month, the readings having been reduced to sea level. It is now proposed to supplement this with two more, giving the computed pressures at elevations of 3,500 and 10,000 feet. Prof. Frank H. Bigelow, upon whose recommendation this innovation is made, and who has, by an elaborate research, made possible the preparation of such charts, hopes that they may in time be of assistance in "seasonal," or long-range, forecasting. Additional data will be required, he says. It will be necessary to know something about temperatures and humidity at the same altitudes. Until these are all available study of the problem can not bear much fruit. Still, a beginning is to be made; and the first step is to note how far the actual pressure for a month at various levels differs from the average of corresponding periods for many years.

Up to the present time no systematic and public predictions of the character here contemplated have been made under governmental auspices anywhere in the world

except in India. Those are based on local principles, and are not applicable elsewhere. One factor, for instance, is the weight of the snowfall in the Himalayas during the previous winter. The outcome, too, has not been especially encouraging. Whatever be the success of Professor Bigelow's plan, it is already obvious that its basis is far more rational and his method less empirical than any other which has yet been proposed. He does not, it is safe to assume, expect to be able to indicate the exact details for any particular date and spot, as countless "cranks" attempt to do. The utmost which it will ever be feasible to accomplish in the long-range work, it may be confidently asserted, is to outline the general situation over comparatively wide areas for two or three weeks, or perhaps a month or more, in advance. Yet, if nothing more is accomplished than this—a correct hint of a tendency toward even a trifling excess of heat or cold and a disposition toward an abundance or scarcity of rain—the benefit to the country will be enormous.

It is not incredible that a second advantage may be secured from a more careful examination of conditions existing at two or three standard planes in the upper air. When actual temperatures at various elevations above the earth are ascertained by means of kites, it is found that the rate of decrease with height is not uniform. Sometimes it is more rapid than the established average, and sometimes it is slower. A knowledge of the existence of these abnormal temperatures might help the forecaster in the short-range work now officially sanctioned. At present the Government meteorologists are bothered by several eccentricities in the behavior of those barometric depressions which constitute the chief feature of all daily maps. One is a departure from the ordinary routes which low areas follow in crossing the country; a second is a remarkable variation in their speed; and the third is uncertainty about the amount of rain which will attend them. The last is the most serious in its effects, but they are all highly embarrassing. If, by minimizing such uncertainties, a study of the upper air will improve the daily forecasts, it should be pushed as far as is practicable. At times, the Government service, while all that the present state of meteorological science will permit, perhaps, is far from realizing the ideal of its founders or the demands of the public. If anything better is possible, the country wants it.—*New York Daily Tribune, April 30, 1903.*

LOCAL WEATHER SIGNS.

The following summaries of local weather signs are based on special reports of observers to the Chief of the United States Weather Bureau:

ABILENE, TEX.

During late spring, summer, and early autumn precipitation is usually preceded twelve to twenty-four hours by south to southeast winds and falling barometer, and the barometer generally falls to 29.80 or below before precipitation begins. During the colder months precipitation often begins when the barometer has fallen to 30 and is on the turn from falling to rising, and at the time the wind shifts to colder northwest.

Precipitation is preceded by relative humidity that increases to 75 or 80 per cent.

Cirrus and cirro-stratus clouds move from the west, but the relation of these clouds to rain has not been noted by the observer, who associates stratus and cumulo-nimbus clouds with rain.

The highest winds of winter come from the northwest with rising barometer, and of summer from the southeast with falling barometer.

During periods of abnormally high temperature south to southeast winds prevail, except in summer, when they come from the southwest. During periods of abnormally low temperature the winds are from westerly in spring and winter, and from northwesterly in summer and autumn.

Frost is most likely to damage crops in April and November.

The conditions most favorable for frost are: Rising, or high and stationary, barometer, temperature falling to 40° or below, increasing relative humidity, clear weather or cirrus clouds, and light west to north winds.

ALBANY, N. Y.

Precipitation is usually preceded in all seasons by south and southeast winds, which set in twenty-four to forty-eight hours before precipitation begins, and barometric pressure which usually falls to or below 29.90 to 29.95 in spring and summer, and to 30 inches or below in autumn and winter.

Except in the presence of fog, which indicates clearing weather, the relative humidity generally increases during twenty-four hours preceding precipitation.

Usually, but not necessarily, cirrus clouds moving from the west precede precipitation about twenty-four hours in all seasons. Alto-stratus clouds from the west or southwest usually precede rain from twelve to forty-eight hours. In spring and summer detached cumulus clouds, moving rapidly from the southwest under a veil of alto-stratus, sometimes appear about twelve hours before rain.

In spring, summer, and winter, high north to west winds usually occur with a rising barometer, and in autumn with a falling barometer and wind from the southeast. In all seasons wind is from the south during periods of abnormally high temperature. In spring and winter the cold winds are from the west and north, in summer from west, and in autumn from west to northwest.

Frosts in May and June are most likely to damage fruit, and frosts in September are most likely to damage other crops.

The conditions which precede frost are barometer above 30.12, temperature about 40°, humidity high. In winter there are two kinds of frost, one a shotted-formed frost, the other of a spongy character; the former is observed in advance of "dry" low barometer areas, the latter in advance of storms from the southwest.

ALPENA, MICH.

In spring and summer southeast winds and falling barometer precede precipitation for periods that vary from a few hours to several days, and the barometer usually falls to 29.90 or below before precipitation begins. During the colder months there is frequently light precipitation in the rear of areas of low barometer. In such cases, however, precipitation has occurred in front of the low areas.

Atmospheric moisture is unreliable as an indicator of precipitation, and while in a majority of cases the relative humidity has increased during twenty-four hours preceding precipitation there are many instances of precipitation that have been preceded by a decrease in relative humidity.

The only upper clouds that are at all reliable as indicators of precipitation are the cirro-stratus "veil." These clouds may occur in any season, but are seldom observed. In spring and autumn clouds become stratus several hours before precipitation begins. In summer small, heavy-looking cumulus clouds usually precede rain; in winter stratus and strato-cumulus prevail, and there are but few clear days.

High winds may come from any quarter in any season, but they are more frequent from the northwest with rising barometer. In all seasons abnormally warm winds are usually from the southwest, and cold winds from the west and northwest.

Frost is likely to damage fruit or crops from May 15 to October 1. The conditions favorable for frost are: Clear weather, light winds, decreasing humidity, rising and high barometer, and falling temperature.

AMARILLO, TEX.

South to southeast winds usually set in twenty-four to forty-eight hours before precipitation, with falling barometer, which reaches 29.85 to 29.90 or below in spring and summer and 30.05 or below in autumn and winter. Precipitation begins, however, after the barometer begins to rise, and in the colder months after the wind has shifted to northerly, the most marked exception to this rule being noted in June, when rain commonly begins with falling barometer.

In all seasons there is a rapid decrease in relative humidity until thirty-six to forty-eight hours before precipitation begins in spring and winter, and twenty-four to thirty-six hours before precipitation begins in summer and autumn, and after the minimum per cent has been reached the humidity rapidly increases until rain begins. A sudden and decided increase in humidity indicates precipitation, unless it follows a heavy rain.

In spring cirro-stratus followed by alto-stratus clouds indicate rain. In summer rain follows cirro-stratus, passing through alto-stratus and alto-cumulus to cumulus; in autumn very limited cirro-stratus, soon followed by alto-stratus, and frequently alto-stratus alone precede rain. In winter cirro-stratus are not strongly indicative of precipitation, but usually indicate changes in temperature and wind direction; and precipitation is usually preceded by alto-stratus or stratus clouds. In spring and autumn cirrus or cirro-stratus from west to southwest and in summer and winter from west to northwest are sometimes observed two or three days in advance of precipitation.

Frost is preceded by moderate pressure, low temperature, high relative humidity, light winds, and very few, if any, clouds.

Vegetation of all kinds withstands low temperature remarkably well, but frost from September 1 to October 15 would damage forage crops and range grass when there is sufficient moisture to keep them green.

ATLANTA, GA.

In spring and summer the winds which precede rain come most frequently from east, southeast, and south, and the average length of the period which elapses between the time the wind sets in from these directions and rain begins varies from thirty-four hours in spring to seventeen hours in summer. In autumn northeast to southeast winds usually precede rain for an average period of thirty-three hours. In winter rain is generally preceded by an average period of twenty-two hours by wind from the northeast, east, southeast, or southwest, and

snow usually follows after the wind shifts to northwest. In all seasons the barometer generally falls to or below 30 before rain begins and the temperature has been high for the season.

Rain may, as a rule, be expected when the relative humidity exceeds the normal for the season, and the greater the excess the shorter will be the time before the beginning of precipitation.

In spring, autumn, and winter cirrus clouds early in the day, followed by cirro-stratus from the west, usually precede precipitation by ten to fifteen hours. In summer cirrus or cirro-stratus clouds have not been observed, except in thunder-storm formations.

In all seasons the highest winds come from west to northwest, with rising barometer.

In periods of abnormally high temperature the winds are usually from the southwest in spring, from west to northwest in summer, and from southeast to southwest in autumn and winter. During periods of abnormally low temperature, the wind is from the northwest in spring, autumn, and winter, and from east to northeast in summer. Northwest winds are usually dry winds in all seasons.

The general conditions which precede frost are high or rising barometer, temperature 55° and below, low humidity, light to fresh winds, usually from west to north, and clear or clearing weather.

Frost is most likely to damage fruit or other crops during March and April, and cotton during September and October.

ATLANTIC CITY, N. J.

As a rule precipitation is preceded six to twelve hours by easterly winds and falling barometer, except in summer when the wind that precedes showers is usually from south to southwest. In all seasons the barometer generally falls to 30 or below before precipitation begins, and in summer showers occur with the barometer on the turn from falling to rising.

Owing to proximity to the sea and frequent fogs increasing atmospheric moisture is not an indication of rain, except in summer, when an increase in relative humidity is sometimes noticed eight to twelve hours before general rains, and immediately before local rains.

In spring, autumn, and winter the wind increases steadily in velocity until the beginning of precipitation; in summer, however, the wind is usually light before and during local rains, while local rains and thunderstorms are attended by violent squalls.

Cirrus and cirro-stratus clouds moving from the west are often observed twelve to twenty-four hours before precipitation in spring, autumn, and winter, and cirro-stratus clouds one to twelve hours in advance of summer rains.

The highest winds generally come from the northeast with falling barometer. During periods of abnormal heat the wind is westerly in

summer and autumn, and southwest in spring. In all seasons the cold winds are from west to northwest.

Garden truck is likely to be damaged by frost in April, May, and September.

Heavy frost is usually preceded by rising barometer, falling temperature, light variable winds, and few if any clouds.

AUGUSTA, GA.

In spring, summer, and autumn precipitation is usually preceded twelve to twenty-four hours by south to east winds and falling barometer, and in all seasons the barometer generally falls to 30 or below before rain begins. In summer showers occur under varying barometric conditions.

In all seasons, except summer, there is a decrease in relative humidity about twelve hours before precipitation begins; in summer the relative humidity increases about four hours before rain begins.

During spring strato-cumulus, and in autumn and winter alto-stratus, clouds usually indicate precipitation. Cirrus clouds, moving from the west, are often observed twenty-four hours before rain in spring, and ten to twelve hours before rain in autumn and winter. In summer cirrus clouds from west to southwest often appear two to four hours before rain. In spring, stratus clouds moving rapidly from north to northeast; in summer, strato-cumulus moving rapidly from east to southeast, and in winter, alto-stratus moving slowly from west, presage precipitation.

During periods of abnormally high temperature the wind is from the south in spring, from the northeast in summer, and from the southeast in autumn and winter. During periods of abnormally low temperature the wind is from north in spring, from west in summer, from northeast in autumn, and from northwest in winter.

Heavy frost after rain in the last decade of October will seriously injure the cotton crop; a heavy frost in the middle and latter part of April will damage the peach crop.

The general conditions favorable for frost in spring are rising barometer, temperature 40°, relative humidity 60 per cent, north wind, and cirrus clouds. In autumn and winter rising, followed by falling and low barometer, temperature 50°, relative humidity 50 per cent, west to northwest winds, and cirrus or cirro-stratus clouds.

BAKER CITY, OREG.

In spring, autumn, and winter precipitation is preceded twenty-four to forty-eight hours by southeast winds and falling barometer; rain that falls in summer storms generally comes with rising barometer. In all seasons, except winter, the barometer falls to 29.85 or 29.95, or

below, before precipitation begins; in winter the usual height of the barometer observed at the beginning of rain is about 30.10 inches.

The relative humidity decreases until within twenty-four hours of the beginning of rain. The moisture of the air is unreliable as an indicator of rain, except that the relative humidity is generally low preceding the beginning of precipitation.

In all seasons cirrus, or cirro-stratus clouds moving from the southwest are observed six to seven days before rain. In spring, autumn, and winter rain is generally preceded in the order named by cirrus, cirro-stratus, and stratus clouds, and in summer by cumulo clouds and thunderheads.

During periods of abnormally high temperature the wind is from the southeast in spring, summer, and autumn, and from the southwest in winter. In all seasons during periods of abnormally low temperature the wind is from the south.

Fruit and other crops are most likely to be damaged by frost in April, May, June, September, and October.

The general conditions favorable to frost in summer and autumn are barometer oscillating, temperature changes sudden, wind variable, relative humidity high, cirrus clouds, and clear weather.

BALTIMORE, MD.

In spring the wind sets in from the southeast, and in summer, autumn, and winter from southeast to southwest, with falling barometer before precipitation, and the barometer usually falls to about 30 before rain begins. A wind from northeast to southeast is generally followed by increasing cloudiness, and in the colder months a shift of wind to these directions is closely followed by precipitation.

In about 50 per cent of the instances noted the relative humidity increases for about two days preceding rain.

Cirrus-cloud formations, moving from points between southwest and northwest, are observed twenty-four to forty-eight hours before rain.

The highest winds of spring are from the northwest, of summer from north to northwest, and of autumn and winter from west.

In all seasons during the periods of abnormally high temperature the wind is usually from southeast to southwest, while north to northwest winds generally prevail during periods of abnormally low temperature.

Injury by frost is most likely to occur from the latter part of March to the middle of April. In average seasons crops are safe after that, although damage has been done in the early part of May. In autumn nearly all staple crops of this locality have been gathered before heavy frost occurs. Corn is seldom hurt.

The general conditions favorable to frost are barometer above the normal and rising, falling temperature, decreasing humidity, fair to clear skies, and light north to northwest winds.

BINGHAMTON, N. Y.

East to south winds and falling barometer precede rain twelve to twenty-four hours in spring, autumn, and winter. In summer east to south winds precede rain about twenty-four hours, and the barometer falls until just before the beginning of rain. In all seasons the barometer falls to about 29.90 or 29.95 before rain begins.

Data regarding relative humidity are very incomplete, but in all seasons an increase in relative humidity occurs at least twelve hours in advance of rain.

In about 70 per cent of the instances noted, rain is preceded in all seasons by stratus or strato-cumulus clouds. Cirrus or cirro-stratus clouds, moving from the west, are observed twenty-four to thirty-six hours before precipitation.

The high winds of spring, summer, and autumn are from the west, with rising barometer, and in winter from the south, with falling barometer.

During periods of abnomally high temperature the prevailing winds are from the southwest in spring and summer, from southwest to west in autumn, and from south in winter.

Frost is most likely to damage fruit and other crops in May and September.

The general conditions which precede frost in spring are rising barometer, high temperature followed by rapidly falling temperature early in the afternoon, low humidity, light westerly winds, and clear or rapidly clearing weather in spring and autumn. In autumn the relative humidity increases preceding frost, with the result that dense fogs frequently occur before radiating surfaces reach the freezing point, and radiation is stopped and the frost does not form. Occasionally dense fog occurs after the frost has formed. Frost forecasts for autumn are therefore very difficult to verify.

BISMARCK, N. DAK.

In spring precipitation is preceded by east winds and falling barometer, in summer by southwest winds and barometer "on the turn" from falling to rising, and in autumn and winter with northwest winds and rising barometer. In spring the barometer falls to about 29.80, in summer to about 29.90 before precipitation begins; in autumn the barometer usually stands at about 30, and in winter at about 30 to 30.10, when precipitation begins.

No relation has been observed between the moisture of the air and precipitation.

No observations have been made which connect cirrus or cirro-stratus clouds with approaching precipitation. Neither have any observations been made regarding any special characteristics of cloud formation that presage rain.

The high winds of spring, autumn, and winter are usually from the northwest, with rising barometer, and of summer from southerly, with falling barometer.

During periods of abnormally high temperature the wind is from southeast to south in spring, from south in summer, and from southwest in autumn and winter. During periods of abnormally low temperature the wind is from east to northeast in spring, from east in summer, and from northwest in autumn and winter.

Frost is most likely to damage fruit or other crops in June, August, and September. The general conditions which precede heavy frosts are high barometer, temperature between 30° and 40°, clear weather, and light winds.

BLOCK ISLAND, R. I.

In the spring precipitation is preceded about nine hours by northeast winds and falling barometer, in summer by southwest winds and falling barometer for periods which vary from one to three days, in autumn by northeast winds and falling barometer for ten to twenty-four hours, and in winter by northeast winds and falling barometer for an average period of about ten hours. In all seasons the barometer falls to about 29.90 before precipitation begins, except during the colder months, when precipitation will begin with northeast winds immediately after the barometer begins to fall.

There appears to be a slight increase in relative humidity from one to three days in advance of rain in all seasons; but an increase does not always indicate rain. In many instances the humidity decreases just preceding rain.

In spring, autumn, and winter cirro-stratus clouds moving from the west generally indicate precipitation, and are observed eighteen to twenty-four hours before precipitation begins.

The highest winds of spring are from southeast to southwest, with falling, and from north to northwest with rising barometer; of summer from the southwest with falling barometer; of the autumn from northeast with falling barometer; and of the winter from east to northeast with falling, and from northwest with rising barometer.

During periods of abnormally high temperature the wind is from the southeast to southwest in spring, from the west in summer, from west to south in autumn, and from southeast to south in winter. During periods of abnormally low temperature the wind is from north to northeast in spring, northeast in summer, and north to west in autumn and winter.

On account of the ocean's influence and high average wind velocity frost is infrequent. Freezing temperature after April 15 is, however, liable to do some damage.

BOISE, IDAHO.

In all seasons rain almost invariably begins during the barometric stationary period, or "on the turn" from falling to rising. A steady and regular fall of the barometer may be expected preceding rain, but sharp rises and falls, frequently amounting to 0.10 inch, sometimes occur about the time clearing weather is expected. There are frequently twelve hours of such unsteady barometer after a sufficient rise to warrant fair weather has occurred. The "critical point" of the barometer, as regards precipitation, is not well established. It seems to vary greatly in all seasons and sometimes occurs with the pressure considerably above normal. As a rule, southeast winds set in ten to twelve hours before rain begins in spring, autumn, and winter. In summer the rainfalls are entirely local, and are not necessarily indicated by either wind or barometer conditions.

The moisture of the air can not be depended upon to indicate the approach of rain, and the relative humidity immediately preceding rain, and many times after rain has begun to fall, is surprisingly low.

The clouds preceding rain are usually high cirro-stratus and alto-stratus through which the sun is visible to within a short time preceding the beginning of rain. Lower clouds, coming up quickly, attend the beginning of rain. In spring, autumn, and winter, especially in winter, when cirrus or cirro-stratus clouds are observed in easterly quadrants, unsettled weather usually follows. The halos that result from cirrus clouds are so frequently followed by rain in less than twelve hours that the direction of the clouds during halos has been closely noted. Cirrus and cirro-stratus clouds observed in the west are not forerunners of rain. The best cloud indication of approaching rain is the cirro-stratus observed in the east, whether in spring, autumn, or winter; but in summer the appearance of strato-cumulus, principally in the southwest, is regarded as a good sign of an approaching thunderstorm.

Fruit growers fear the late frosts that occur from about the 10th of May to June 5. It appears that the frosts that occur in spring prior to May 10 are likely to be followed by cloudiness, and the damage which would otherwise result is mitigated thereby. The late frosts are likely to be followed by cloudiness, and the temperature change to much warmer generally does more damage than the frost itself. Fruit is seldom damaged by frost during the fall. Preceding frost the barometer rises with west to northwest winds for twelve hours or more. Under these conditions the temperature falls, the humidity remains high, and heavy lower cumulus clouds appear. Frequently a state of semicloudiness exists after the wind has decreased to a point favorable for frost to form and frost fails to form, except in streaks. Many apparently ideal conditions for frost are turned aside by increasing cloudiness about sunrise.

BOSTON, MASS.

In spring, autumn, and winter precipitation is usually preceded twelve to twenty-four hours by southeast to southwest winds and falling barometer; and in spring, summer, and autumn the barometer generally falls to about 29.90 inches before precipitation begins. In the case of storms that advance from the southern Atlantic coast precipitation closely follows a shift of wind to the northeast and the turn in the barometer from rising to falling. In the spring and winter rapidly rising temperature precedes rain.

There is generally an increase in the humidity of the air preceding well-defined storms or general rains; but, owing to the proximity to the ocean, an increase in humidity is frequently produced by sea breezes and fog when fair weather is assured.

In spring and summer cirrus clouds have not been observed to any marked extent; in autumn and winter cirrus clouds, moving from the west, often precede rain twelve to twenty-four hours. In summer, cirrus and cirrus haze often precede high wind; in autumn, fine types of cirrus and cirro-stratus presage high wind and rain, and these characteristics also obtain for winter.

In spring and autumn high winds usually occur from east to south, with falling barometer. The highest winds of summer generally occur with thunderstorms; in winter high winds occur from east to south, with falling, and from west to northwest with rising, barometer.

During periods of abnormally high temperature southwest winds prevail in spring, summer, and autumn, and south to southwest winds in winter. During periods of abnormally low temperature the direction of the wind is northwest to west in spring and autumn, northeast to north in summer, and northwest in winter.

Frost is most likely to damage fruit or other crops during the last week of May and the first two weeks of June.

The general conditions which precede heavy frost in spring are high and stationary barometer, temperature below the normal, light wind, and clear weather. In autumn the same conditions obtain as in spring, with low humidity.

BUFFALO, N. Y.

In spring and summer precipitation is preceded twelve to eighteen hours by south to southeast winds and falling barometer, and in autumn and winter from eight to fifteen hours by south to southwest winds and falling barometer. The rains of summer usually begin with barometer about 29.80 inches and near the "turn" from falling to rising. In autumn rain also generally begins with barometer near the "turn" from falling to rising, and at a height of about 29.95. In spring precipitation usually begins when the barometer has reached

29.90, and in winter when it has fallen to about 30. In the case of storms that advance from the south or southwest precipitation often begins closely following the shift of wind to the northeast and the turn in the barometer from rising to falling.

As the winds which precede rain are land winds, the relative humidity generally decreases ten to fifteen hours before rain begins.

Cirro-stratus clouds are usually observed twelve hours in advance of rain in spring and summer. In summer cirrus clouds are often seen that are not followed by rain. In autumn and winter cirro-stratus clouds are noted eight to ten hours in advance of rain, but sometimes only a few hours in advance of rain or snow. In all seasons cirrus or cirro-stratus clouds moving from the west or southwest are sometimes observed five to fifteen hours before precipitation begins, the period being longer in spring and summer.

In all seasons maximum wind velocities are usually reached with rising barometer and west to southwest winds.

Precipitation is usually preceded by rising temperature, and begins "on the turn" from rising to falling.

During periods of abnormally high temperature the winds are from the southeast in spring, from south to southeast in summer, from south to southwest in autumn, and from south in winter. During periods of abnormally low temperature the winds are from northwest to northeast in spring and summer, and from north to northeast in autumn and winter.

Frost is most likely to damage fruit or other crops from May 10 to June 1, and from September 10 to October 1.

The general conditions which precede heavy frost are clearing weather, high pressure, temperature which will fall to a point between 40° and 35°, diminishing westerly winds, and clear weather in the morning.

CAIRO, ILL.

The observer has often noticed that when the barometric pressure is near the normal, but falling at the time of the evening observation, rain usually follows within twenty-four hours; on the contrary, with a rising barometer at the evening observation, although cloud conditions portend rain, the weather usually turns out fair. In spring and winter southeast winds usually set in twenty-four to thirty-six hours before precipitation, and precipitation begins with the barometer about stationary or "on the turn" from falling to rising. In summer rain is preceded for an indefinite period by southwest winds, and begins with the barometer rising or "on the turn" from falling to rising. In autumn south to southeast winds precede rain, and rain usually begins with falling or stationary barometer, and often when the barometer is rising or "on the turn" from falling to rising. In

spring and summer the barometer usually falls to 29.95 or 29.90 before rain begins; in autumn and winter 30.10 or below before precipitation begins.

In all seasons precipitation is usually preceded by relative humidity about or above normal, or rapidly increasing. However, these conditions are frequently followed by a continuance of fair weather. Precipitation seldom follows within twelve hours an observation at which the moisture of the air is considerably below the normal, except in the winter months, when such conditions are sometimes followed by light snow.

A record of all clouds observed during the day and into the night shows that cirrus and cirro-stratus clouds are as often followed by fair weather as by precipitation. In autumn and winter alto-stratus clouds are usually followed by rain within twenty-four hours; in spring and summer low banks of stratus clouds in the west in the early morning are usually followed by thunderstorms in the afternoon.

During periods of abnormally high temperature the wind is from the southeast and southwest in spring, from southwest to northwest in summer, and from southeast to southwest in autumn and winter. During periods of abnormally low temperature the wind is north to northwest in spring and winter and from northeast to northwest in summer and autumn.

Frost is most likely to damage fruit or other crops any time after April 10 or before November 15.

The conditions which usually precede heavy frost are, barometer normal or above, temperature 36° or below, humidity about normal, gentle winds and cloudless sky.

CAPE MAY, N. J.

In spring and winter precipitation is usually preceded by easterly winds ten to twelve hours, and occasionally by northeast winds which shift to that quarter almost simultaneously with the beginning of rain. In summer winds are usually from south, and in autumn from southwest to southeast, preceding rain. In all seasons the barometer falls to 30 inches or below before rain begins, except when winds shift to the northeast.

The moisture of the air usually increases one to two days preceding rain, and the relative humidity is generally about 90 per cent when precipitation begins.

Cirrus or cirro-stratus clouds moving from the west are often observed one to two days before precipitation in spring, summer, and winter. In autumn alto-stratus clouds usually precede rain.

The high winds of this locality are from the east with falling and from the west with rising barometer.

During periods of abnormally high temperature the winds are from

west to northwest in spring, from south to southwest in summer and autumn, and from east to south in winter. During periods of abnormally low temperature the prevailing winds are from west in spring, from northeast in summer, and from northwest in autumn and winter.

Frost is most likely to damage fruit or other crops in April and September. The conditions favorable for frost are high barometer, temperature 40° or below, low humidity, light north to west winds.

CARSON CITY, NEV.

In spring, autumn, and winter the wind usually sets in from west to southwest one to three days before rain begins. In summer precipitation occurs with thunderstorms, and the wind which precedes rain may come from any direction, but generally from west to southwest. In all seasons precipitation is usually preceded by falling barometer, and begins with the barometer "on the turn" from falling to rising. The barometer usually falls to 29.85 or 29.90 inches before rain begins.

Very little relation has been observed between the moisture of the air and rain. It is not believed that the relative humidity increases or decreases to any great extent preceding precipitation.

Cirrus or cirro-status clouds presage rain in all seasons, and are usually observed moving from the west twelve to twenty-four hours before rain begins. Heavy banks of stratus or strato-cumulus clouds over the mountains west of the station, moving rapidly from the west and southwest, presage precipitation at any time during the year.

High winds usually occur from the southwest with falling barometer.

During periods of abnormally high temperature the wind is from the south and southwest in spring, autumn, and winter, and from west in summer. During periods of abnormally low temperature the wind is from west to northwest in spring, autumn, and winter, and from the west in summer. In spring two or three successive days of high temperature are generally followed by thunderstorms and rain, mostly on the surrounding mountains. Moderate barometric depressions are usually followed by decided falls in temperature in all seasons.

Frost is most likely to do damage during the last half of May. Moderately low pressure, increasing temperature and humidity, overcast sky, and precipitation usually precede heavy frost during spring, autumn, and winter.

CHARLESTON, S. C.

In spring rain is preceded twelve to twenty-four hours by falling barometer and southwest winds, and the barometer usually falls to about 30 before rain begins; in summer rain is usually preceded twenty-four to thirty-six hours by southwest winds. The heaviest

rains of early summer usually occur with abnormally high barometer and when the barometer is "on the turn" from rising to falling. The period of heavy summer rains sets in about June 10 of each year. In autumn rain is preceded twelve to thirty-six hours by west to southwest winds, and usually with falling barometer, although occasionally with small rise in barometer.

In spring there is a decided increase in relative humidity when winds are from the southwest eight to twenty-four hours before rain. When the wind is from the southeast, east, and northeast there is very slow and slight increase in humidity six to twenty-four hours preceding rain, owing to the fact that the winds from these directions are from the ocean. In summer there is a decided increase in relative humidity eight to twenty-four hours preceding rain when the wind is from the southwest. High humidity, increasing slowly eight to sixteen hours preceding rain, is observed when winds are from the south, southeast, east, and northeast. In autumn there is a rapid increase in humidity six to sixteen hours before rain when winds are from southwest during September; high humidity increasing slowly six to sixteen hours before rain when winds are from south, east, or northeast during October and November; in winter the humidity increases slowly six to sixteen hours before rain with winds from southeast, east, or northeast, and increases rapidly six to sixteen hours before rain with winds from southwest.

In spring cirrus clouds appear immediately after the passage of a crest of high pressure, and assume the cirro-stratus form; alto-stratus next appear, followed by strato-cumulus, when rain begins. Cirro-stratus and alto-stratus are both indicators of rain. In summer the upper clouds play an unimportant part in the prediction of rain. The lower clouds, cumulus and strato-cumulus, more often precede rain than any other clouds. Late in August, however, after a period of frequent thunderstorms, cirro-stratus and alto-stratus appear in advance of approaching tropical storms and can usually be relied upon as forerunners of rain. In autumn cirrus and cirro-stratus clouds are more numerous than in summer, and late in October and November cirrus and cirro-stratus are usually forerunners of rain. In winter cirrus and cirro-stratus clouds, particularly cirro-stratus, are forerunners of rain. The interval between the appearance of cirro-stratus before that of alto-stratus is short, and rain closely follows the formation of alto-stratus clouds. The elevation of the cirrus and cirro-stratus is much lower in winter than in summer, frequently reaching the cumulus and strato-cumulus levels, and their velocity is about twice as great as that of the lower clouds.

Frost is most likely to damage fruit or crops from March 1 to April 25, and from October 25 to December 15. In spring frost is usually preceded by increasing barometer, day temperature—ranging between

50° and 60°—low dew-point, normal humidity, and light winds between southwest and north points. Frost occurs in this section with air temperature as high as 49°, and, in the vicinity of the station, frost has been known to form in ravines and low lands with air temperature about 52°. With other conditions favorable to frost, it rarely occurs with northeast winds. In autumn frost does not form in September and seldom in October. In November when the barometer is rising and winds are from southwest to northwest and decreasing, with cloudless sky, and low dew-point, and an evening temperature of 50°, heavy frost may be expected during the night. Heavy frost can form with observed air temperature as high as 40°. In winter heavy frost occurs with daily night temperature about 45°, relative humidity 70 to 80 per cent, winds light and from southwest to north, clear sky, and high and increasing pressure.

CHARLOTTE, N. C.

In summer and autumn southeast winds and falling barometer precede rain six to twenty-four hours, and rain generally begins with barometer falling or "on the turn" from falling to rising. In all seasons the barometer usually falls to 30 or below before rain begins, except when storms come from the southwest.

The relative humidity increases in advance of thunderstorms in summer, and to a lesser degree in advance of general rains; the period is not definite and may be days or only hours. The amount of moisture in the air is no indication of coming rain as a rule, excepting immediately before a rain. The few observations taken, usually twice a day, are not sufficient to treat questions very favorably.

No definite rule can be made with regard to the relation between cirrus and cirro-stratus clouds and precipitation. Occasionally several veils of cirrus clouds come and go within twenty-four hours of the beginning, especially in autumn. In probably more than one-half of the instances clouds of this type do not precede rain.

In summer the highest wind velocities usually occur with a falling barometer; in autumn and winter the maximum velocities occur more frequently with a rising barometer than in summer. In many cases there are decided rises or falls in the barometer without corresponding wind velocities.

During periods of abnormally high temperature the wind is from the southwest in summer and from south to southwest in autumn. During periods of abnormally low temperature the wind is from the northwest in summer and from northeast to northwest in autumn. (Data regarding the barometer and the wind as indicators of rain has not been furnished from this station for the spring and winter seasons.)

Frost is most likely to damage fruit or other crops after April 1 and before November 1.

Frost is usually preceded by slowly rising barometer, temperature falling or stationary, humidity depending on temperature and clearness of the sky, light winds from northeast to northwest quadrants, and clearly defined cumulus clouds, diminishing at sunset.

CHATTANOOGA, TENN.

In spring south winds and falling barometer precede precipitation twelve to twenty-four hours; in summer northeast winds set in twenty-four hours before rain, and are attended by falling barometer. During a thunderstorm, however, the relation between "rain winds" and the movement of the barometer is variable and uncertain. In autumn the wind and barometer conditions preceding rain are similar to those in spring; in winter northeast winds set in with falling barometer twelve to twenty-four hours before precipitation begins. In all seasons the barometer falls to about 30 on an average before precipitation begins.

The percentage of relative humidity is usually low twenty-four hours in advance of rain; occasionally, however, a gradual increase is noticed for forty-eight hours. In summer there is a gradual increase in atmospheric moisture twenty-four to forty-eight hours preceding general rains; in autumn and winter the relative humidity increases before rain for periods which vary from twenty-four to seventy-two hours.

In general the interval in cirrus and cirro-stratus clouds is only a few hours when rain is approaching, and the change from cirro-stratus to alto-stratus takes place rapidly. All gradations, from cirrus to strato-cumulus in the southwest, are visible. Rain usually follows a quantity of cirro-stratus and alto-stratus clouds within thirty-six hours if their direction is from southwest. In all seasons the prevailing direction of cirro-stratus clouds is from the west. As a rule, when the sky is partly clouded with cirro-stratus clouds from the southwest rain can be expected in thirty-six hours during the spring season; in summer, as a rule, four-tenths, or more, of alto-stratus clouds from westerly directions indicate rain in thirty-six hours; in autumn, when the sky is partly overcast with alto-stratus clouds, moving from the south, southwest, or west, rain may be expected in twenty-four hours; in winter four-tenths, or more, of cirro-stratus or alto-stratus clouds from the southwest or west indicate rain in thirty-six hours; in summer also types of cumulus clouds seen over the northwest, or west, or southwest horizons in the morning indicate thunderstorms in the afternoon.

During periods of abnormally high temperature the prevailing winds are southerly in spring, autumn, and winter, and southwest in summer. During periods of abnormally low temperature the pre-

vailing winds are from the northwest in spring, autumn, and winter, and from the north in summer.

Frost is most likely to damage fruit or other crops from March 1 to May 15, and from September 15 to October 30.

The general conditions which precede frost are rising pressure, falling temperature, decrease in humidity, brisk winds, and clearing weather. Frosts usually occur in the midst of an area of high barometer.

CHEYENNE, WYO.

In spring, autumn, and winter rain or snow usually begins with rising barometer, yet some of the heaviest snowstorms of the winter and spring occur when the barometer is nearly stationary after falling. In all seasons, except winter, the barometer falls to 29.90 or below before precipitation begins, except in winter, when precipitation often begins with the barometer ranging from 30 to 30.15.

A close observation leads to the belief that the humidity observations are of no value at any season in forecasting precipitation at this station. Cirrus or cirro-stratus clouds are sometimes observed moving from the northwest, but the observer states that he has never observed any connection between these clouds and precipitation, and that he can not say that any kind of clouds can be regarded as forerunners of rain.

There are no crops or fruits of any kind grown in this locality which would be damaged by frost, except a very few small garden patches in the city.

CHICAGO, ILL.

In general the barometer begins to fall, with southerly winds, ten to twelve hours before precipitation begins. In the case of summer thunderstorms the barometer usually falls quite rapidly two to six hours before the storm; during the storm the barometer rises suddenly and then again falls gradually. Clearing weather is nearly always preceded by rising barometer; the rise, however, may not be more than an hour or so in advance of the clearing weather.

In spring an increase in humidity frequently becomes apparent twenty-four hours before rain (especially in March) when winds set in from the east quadrants, this increase becoming pronounced twelve hours in advance. Snow is most frequent with relative humidity 60 to 80 per cent. In summer and autumn decreasing humidity usually precedes rain twelve to twenty-four hours, the decrease being marked ten to twelve hours before rain begins. In winter precipitation is preceded more frequently by increasing humidity, although it often follows decreasing humidity. It can hardly be said that the moisture in the air, with its surface local variations, as expressed in relative humidity, is a reliable index of rain in this locality. Low,

high, increasing, and decreasing humidity are all followed by rain, and nearly as frequently by no rain. Months and years differ decidedly in this respect; the only marked fact is that a considerable decrease in humidity usually precedes summer storms.

Cirrus and cirro-stratus clouds are not so frequent in March, but in April and May they usually precede rain, appearing one to two days in advance. However, cirrus and cirro-stratus clouds occur with equal frequency that are not followed by rain. In summer cirrus and more frequently cirro-stratus clouds appear in advance of rain, but these clouds appear with even greater frequency before fair weather. In autumn strato-cumulus clouds are forerunners of rain, but upper clouds appear very frequently without being followed by rain. In winter cirrus and cirro-stratus clouds appear frequently before rain, and much more frequently they are not followed by rain or snow. The cirrus and cirro-stratus clouds observed usually move from the west in spring, summer, and winter, and from southwest to west in autumn. A lowering or transforming of cirro-stratus to strato-cumulus most frequently precedes rain from six to twelve hours; also cumulo-stratus from southwest finally taking the surface wind direction. This applies to both spring and summer. In autumn a lowering of alto-stratus and strato-cumulus into stratus occurs two to twelve hours in advance of precipitation, and in winter a lowering of cirro-stratus to stratus and then to nimbus occurs two to twelve hours in advance of rain or snow.

In spring high winds are usually southerly with falling and southwest with rising barometer; in summer south to southwest with falling barometer; in autumn south with falling barometer; and in winter south with falling, and west, northwest, and northeast with rising barometer.

Frost is most likely to damage fruits or other crops from April 10 to May 10, and from September 25 to October 10.

Heavy frost in spring and autumn is usually preceded by moderately high pressure, temperature 40° or below, high humidity if light and low humidity if heavy frost, light winds, and cloudless sky.

CINCINNATI, OHIO.

In spring, summer, and autumn precipitation is most frequently preceded twelve to forty-eight hours by southeast winds and falling barometer, and the barometer usually falls to 30 or below before precipitation begins; in winter precipitation is preceded by south to southwest winds, and the barometer falls to about 29.90 before rain begins. In nearly every case during rain periods the rain continues when the barometer is "on the turn" and rising. When the rain is light the barometer remains nearly stationary previous to beginning and during its continuance.

Humidity observations appear to be of little value in forecasting. In general there is an increase in humidity before rain, but for what period in advance can not be determined. The fact is recognized that when we say, "It feels like rain or snow," the feeling is produced by increasing atmospheric dampness.

No observations have been made with regard to the extent that cirrus, cirro-stratus, or other clouds are forerunners of rain.

Frost is most likely to damage fruit from the middle of April to the end of May and during the month of October.

The general conditions which precede frost are increasing barometer, falling temperature, low humidity, light west to northwest winds, and clearing or clear weather.

CLEVELAND, OHIO.

Precipitation is usually preceded thirty-six to forty-eight hours by southeast to southwest winds and falling barometer, and the barometer generally falls to 29.80 or below in spring and summer, and to 29.90 or below in autumn and winter before precipitation begins. In all seasons, when the barometer falls rapidly, with wind backing from south to brisk northeast, the precipitation is likely to be copious.

There is usually an increase in relative humidity following a dry period, which continues irregular up to a few minutes before the beginning of rain; the increase is then rapid during a period of perhaps ten or fifteen minutes. The moisture of the air is not considered in itself an aid in forecasting.

Very little reliance can be placed in any season on the appearance or formation of cirrus or cirro-stratus clouds as indicators of precipitation. The cirrus and cirro-stratus clouds which appear are generally observed moving from southwest or west-southwest.

High winds of spring are from southwest to northwest with rising barometer; of summer from west to north with rising barometer, and frequently from southeast to south with falling barometer; of autumn and winter from southwest to northwest with rising barometer.

In all seasons abnormally high temperature is attended by southeast to southwest winds, while a change from abnormally low temperature, or from warm to cold, sets in with a shift of wind from the south to the northwest or north. The lowest temperatures during the colder half of the year are not registered until the wind is again from the south quadrant.

Spring frosts as early as April 5 in advanced seasons, but usually not until May 1, are likely to damage fruits or other crops. In autumn frosts as early as September 20 will damage crops. From September 20 to November 20 is the period when warnings of frost or freezing weather are most desired by vegetable and fruit growers.

The warnings of severe freezes in November are greatly valued by truck gardeners.

At 8 a. m. of the day immediately preceding frost the conditions in the majority of cases are as follows: Pressure above normal and increasing, temperature decidedly below normal as a rule, relative humidity variable but generally above the normal, wind direction irregular, but southerly winds are most frequent; force of wind varying from gentle to fresh; clear weather is found in about 50 per cent of the cases examined, and cumulo-stratus clouds are more frequent than any other type.

COLUMBIA, MO.

Precipitation is usually preceded twelve to twenty-four hours by south to southeast winds and falling barometer, and the barometer generally falls to 29.90 or below before rain begins. In summer and autumn, however, rain usually begins with the barometer "on the turn" from falling to rising.

There is usually a decrease in relative humidity one to two days preceding precipitation, although an increase is sometimes observed.

Cirro-stratus clouds general, thickening, and followed by alto-stratus and alto-cumulus, often precede rain or snow in autum and winter. In about 33 per cent of the instances noted, precipitation is preceded one to two days by cirro-stratus clouds moving from the west in spring, summer, and autumn, and from the northwest in winter.

High winds are usually from the northwest with rising barometer in spring and autumn, from the west in summer, and from southwest to northwest in winter.

In all seasons the highest temperatures accompany southerly winds, and periods of abnormally low temperature are attended by northwest winds.

Frost is most likely to damage fruit or other crops from March 20 to April 30 and from September 15 to October 15.

Frost is usually preceded by high barometer, falling temperature, normal or low humidity, west to north winds, and clear or clearing weather.

COLUMBIA, S. C.

In spring precipitation is preceded ten to twenty hours by northeast to southeast winds and falling barometer; in summer, six to twelve hours by southeast winds and moderately low barometer, and in autumn and winter, twelve to forty-eight hours by northeast winds and falling barometer. In all seasons the barometer usually falls to 30 inches or below before precipitation begins.

In spring and winter relative humidity increases twelve to twenty-four hours before precipitation, while in summer and autumn there

is a decrease in relative humidity twelve to twenty-four hours before rain, followed by an increase.

Cirrus or cirro-stratus clouds are almost invariably observed before general storms, but not before local storms in spring and autumn, and they appear ten to twenty-four hours before rain begins, moving from the west or northwest; in summer clouds of this class are seldom observed; in winter cirrus or cirro-stratus clouds, moving from the northwest, are often observed eight to twenty hours before rain. In summer and autumn low, small cumulus clouds hanging over the river early in the morning are a sure sign of rain before night; in autumn low, moderately or fast moving stratus, dark colored, and of dense texture, forerun rain.

Late in February and early in March, after an abnormally warm winter, or late in March and early in April after a normal or moderately cool winter, or late in April or early in May after an abnormally cold winter, frost will damage fruit. Truck is subject to damage by frost from February to May; strawberries in March and April; corn and cotton late in April or early in May, and cotton in October.

The general conditions which precede frost are rising pressure, low humidity, and light winds.

COLUMBUS, OHIO.

In spring and autumn precipitation is most frequently preceded by southeast winds and falling barometer, and the barometer generally falls to about 30 inches before rain begins; in summer southerly winds and falling barometer precede rain, and rain usually begins just after or "on the turn" from falling to rising barometer; in winter southwest winds and falling barometer usually precede precipitation, and the barometer falls on an average to about 29.85 inches before rain begins.

The relative humidity seems to change very little until nearly the time of the beginning of rain; sometimes it is lower than usual, and, in some instances, a slight increase is shown several hours before rain begins. Increases in relative humidity that have been noted are invariably at the beginning or early in the rain period. There seems to be a decidedly high humidity at the beginning of rain, which becomes less as rain continues. If the humidity is high and the temperature fall promises to be decided, the rainfall is usually heavy.

While cirrus clouds are nearly always observed before rain, and cirro-stratus clouds have been marked before a heavy rainfall, the cirrus clouds are so frequently noted when no rain follows that they are not considered of much value in forecasting. Strato-cumulus clouds are usually followed by rain in ten to eighteen hours; cirrus and cirro-stratus clouds have been observed forty-eight hours before rain, and again rain has occurred within twelve hours after their appearance. The average interval is estimated at thirty-six hours.

Cirro-stratus clouds are observed moving from the west in spring and autumn, from west to southwest in summer, and from west to northwest in winter. The following special characteristics of cloud formations often presage rain: Upper clouds of the cirrus type are followed by haze and very delicately fibered cirro-cumulus. All classes of cirrus clouds are noted, and their movements are usually rapid; alto-stratus follow, and their direction is most favorable for rain when they are from south to southwest. The varied movements and marked character of each type of clouds in the order observed presage rain.

In summer high winds usually occur with falling barometer or barometer "on the turn" from falling to rising, and are easterly when the barometer is falling and westerly when it is rising. The high winds of summer, autumn, and winter are southwest to northwest with rising barometer.

During periods of abnormally high temperature the wind is from the southeast to south in spring, from southwest in summer, from south in autumn, and from south to southeast in winter. During periods of abnormally low temperature the wind is from north to northwest in spring and autumn, from northeast to northwest in summer, and from southwest to northwest in winter.

Frost is likely to damage fruit after April 15, and after about May 15 it will injure garden crops and field corn. In the fall late garden crops and field corn are injured as late as September 25 to October 1, and injury is sometimes caused to late potatoes as late as October 15.

The conditions favorable to frost are high and nearly stationary barometer, low temperature, no clouds, very light winds, and low humidity. In several instances, however, heavy frost, with temperature at freezing or below, did very little damage to fruit in blossom, and this fact was attributed by local farmers to the dryness of the air.

CONCORDIA, KANS.

In spring rain is preceded twenty-four to thirty-six hours by southeast winds and falling barometer; in summer and autumn rain is preceded thirty-six to forty-eight hours by south to southeast winds and falling barometer, and precipitation begins when the barometer is "on the turn" from falling to rising; in winter precipitation is preceded twelve to twenty-four hours by falling barometer. In summer and autumn the barometer is nearly stationary for about forty-eight hours, then falls rapidly during the twelve hours immediately preceding rain, and rises rapidly during rain and for several hours after rain begins.

In spring and autumn the relative humidity increases as rain approaches; in summer very little moisture precedes rain; in winter, if winds are northeast, increasing relative humidity indicates snow.

In spring cirrus clouds, moving from the southwest, appear forty-eight hours in advance of rain, and before rain begins are followed by alto-cumulus and alto-stratus clouds in summer. Cumulus clouds sometimes precede rain, but rain is always preceded by strato-cumulus clouds in this season. In autumn cirrus clouds moving from the southwest appear thirty-six hours in advance of rain and are followed by alto-stratus clouds. In winter a few cirrus clouds, moving from the southwest, sometimes appear twenty-four to thirty-six hours in advance of precipitation and are followed by alto-stratus clouds.

In spring high winds occur from the south and southeast, with fall ing barometer; in summer from south to southwest with falling, and from northwest with rising barometer; in autumn from south with falling, and from northwest with rising barometer; in winter from north and northwest with rising barometer.

During periods of abnormally high temperature the winds are from south to southeast in spring and winter, from south to southwest in summer, and south in autumn. During periods of abnormally low temperature the winds are from north to northwest in spring and winter, from north to west in summer, and from northwest in autumn.

Frost is most likely to damage fruit or other crops in April and the early part of May.

In spring and autumn the conditions favorable for frost are barometer normal or above, temperature below normal, humidity normal or below, light winds, clear weather, or rapidly decreasing cloudiness.

CORPUS CHRISTI, TEX.

In spring rain is usually preceded about twenty-four hours by backing east and northeast winds and barometer "on the turn" from falling to rising, and rising. In this season a steady fall in barometer with wind from the southeast means clearing weather. In summer easterly winds backing from southerly precede rain twenty-four to thirty-six hours, and rain usually begins after the barometer has fallen to 29.90 or 30 inches and begins to rise. After periods of low barometer in summer, showers follow on the rise if the winds are backing; if the barometer is 29.80 and falling no rain occurs until the rise begins; when the barometer is above 30 and fluctuating thunderstorms and heavy rains are likely to occur. In autumn rain is generally preceded about twenty-four hours by east to northeast winds and rising barometer, except in November, when rain follows falling barometer and winds north and veering. In winter northeast winds usually precede rain twelve to twenty-four hours with barometer falling; rain also occurs with rising barometer and backing southerly winds. In all seasons the barometer falls to a height of 29.90 to 30 inches before rain begins.

In spring and summer there is a notable decrease in relative humidity thirty-six to forty-eight hours before precipitation begins, but nearly all rainfall occurs with relative humidity between 80 and 90 per cent. In autumn and winter the humidity increases twelve to twenty-four hours before precipitation to about 90 per cent in autumn and to 80 per cent or above in winter.

Cirrus or cirro-stratus clouds do not to any extent indicate precipitation when moving from the northwest, west, or southwest, but rain follows in thirty-six hours when these clouds are observed moving from the north. In summer cirrus and cirro-stratus clouds from the south and southeast are sometimes followed within thirty-six to forty-eight hours by rain. In autumn and winter cirrus or cirro-stratus clouds from the south are almost invariably followed by rain within thirty-six hours. In summer lower cumulus, changing shape and color, with rising barometer, presage rain.

In spring the highest winds usually occur from the southeast, with falling barometer; in summer from the northeast with falling, and from north to west with rising barometer; in autumn from north and northwest with rising barometer, except in September, when they come from east to northeast with falling barometer; in winter from the north and northwest with rising barometer.

During periods of abnormally high temperature the winds are usually from the southeast in spring, except sometimes from the west in May; in summer the winds are westerly; in autumn the warm winds are westerly in September and October and southeasterly in November; the warm winds of winter are from the southeast. During periods of abnormally low temperature the winds are from north to northeast in spring and autumn, from easterly in summer, and from northeast to northwest in winter.

Frost is most likely to damage fruit or other crops from November 15 to March 20. Vegetables are raised during all the winter months when there is sufficent rainfall; after the 15th of January is the most critical time, however. Shipping to northern markets begins in February and continues to about the last of April.

The general conditions most favorable to frost in spring and autumn are high barometer, temperature 38° and below, humidity 70 per cent and under, clear weather, brisk north to westerly winds, subsiding at sunset; in winter high barometer, temperature 45° and below, relative humidity 70 per cent and under, and clear weather. Frost is not a frequent occurrence at any season; it generally follows after the low barometer area has crossed the meridian twenty-four to thirty-six hours, and the center of the high barometer area is west and south of the Missouri River. A gathering of cirro-stratus or alto-stratus clouds in the west is an indication of a rapidly diminishing high barometer area, and frost is not likely to occur at such times.

DAVENPORT, IOWA.

Precipitation is usually preceded about twenty hours by northeast to southeast winds and falling barometer, and the barometer generally falls to 29.90 in spring, 29.95 in summer and autumn, and 30 in winter before precipitation begins. In summer, however, showers are often preceded by southeast to southwest winds and come "on the turn" of the barometer from falling to rising. With a falling barometer rain usually begins with a pressure of about 29.95 inches, though during the passage of very energetic storms the beginning of rain is often delayed until the barometer has nearly reached its lowest point, and sometimes until about the time it begins to rise. With a rapidly rising barometer after the passage of a storm of decided energy rain usually ceases before the barometer has risen to 29.90 inches. Before summer thunderstorms the barograph trace is, in most cases, very jagged and irregular.

There is usually a decrease in relative humidity about eighteen hours before precipitation begins. At times, however, there is an increase in humidity two to six hours before rain falls.

During the warm season of the year, from late spring to early autumn, cirro-stratus clouds are generally observed along the western and southwestern horizon twelve to eighteen hours before the beginning of rain. No particular cloud formation that can be relied upon as a guide has been observed during the cold season. During the warm season before a thunderstorm which occurs in the following late afternoon, evening, or night banks of cirro-stratus clouds generally extending upward only a few degrees are almost invariably noticed along the southwest and western horizons in the morning. A peculiar hazy condition of that portion of the sky is also noticed at such times.

During periods of abnormally high temperature the prevailing winds are from the east, southeast, and west in spring; from south to southwest in summer and autumn, and generally from the southwest in winter. During periods of abnormally low temperature the winds are from northeast to northwest in spring and summer and from northeast to northwest in autumn and winter.

Frost is likely to prove injurious to fruit or other crops after May 1 and before October 1. Late frosts which occur after May 1 are likely to damage fruit trees or early garden truck; and early frosts occurring before October 1 would be likely to prove injurious to garden truck. Cereals are generally out of danger by the middle of September.

The heavy frosts of spring are usually preceded by a rising or high pressure, relatively low and falling temperature, low humidity, light west and north winds, and clear skies. In early autumn frosts are preceded by nearly the same conditions as those noted for spring.

DENVER, COLO.

In all seasons precipitation is generally preceded several hours by northeast winds, and begins with rising barometer. The usual height of the barometer observed at the beginning of precipitation is 29.90 in spring, 29.95 in summer and autumn, and about 30.15 inches in winter.

The moisture of the air is not an indicator of approaching precipitation, and an increase or decrease in relative humidity is observed occasionally only an hour or two in advance of precipitation.

During the colder half of the year cirrus clouds from the west are generally a reliable indication of a low barometer area in the northwest and rising temperature. A long and narrow bank of stratus clouds above the mountains in the west at about 30° altitude is indicative of chinook conditions within twenty-four hours. In summer cumulus clouds on the mountains early in the morning rapidly develop thunder-storm conditions if pressure distribution is favorable to northeast winds.

The highest winds of spring and autumn are from northwest, with rising and from southwest with falling barometer; and of winter from northwest with rising barometer.

Westerly winds prevail during periods of abnormally high temperature. During periods of abnormally low temperature the winds are northeasterly during the day and southerly at night.

Frost is most likely to damage fruit or other crops between April 10 and September 30.

The conditions which usually precede frost are high barometer, temperature below 44°, humidity above normal, light precipitation, light winds, and clearing weather, with no clouds when frost occurs.

DES MOINES, IOWA.

Precipitation is generally preceded twelve to twenty-four hours by southeast winds and falling barometer, and in spring, summer, and autumn the barometer usually falls to 30 or below before precipitation begins. In winter precipitation often begins when the barometer has fallen to 30.10. During fair weather, which has prevailed for several days, a sudden rise, followed by falling barometer, usually indicates the near approach of rain, and when the barometer begins to rise during a general rain or snowstorm clearing weather will soon follow. Summer showers often occur without an apparent regard to barometric movements.

It has been found that, as a rule, the relative humidity increases slightly before the beginning of rain; at other times there is a decided increase in humidity at least twelve hours before rain; while at times no increase in the moisture of the air has been noted until after precipitation has begun.

Cirrus and cirro-stratus clouds moving from the northwest are sometimes observed twelve to twenty-four hours before precipitation. The most characteristic cloud formation that presages precipitation is a peculiar and distinctive type of cirro-stratus, frequently called sheet cirro-stratus. These clouds present a hazy appearance, cover a small area, and usually are of short duration. The type of cirro-stratus known as "mackerel sky" also presages rain, but this type is not so frequent nor so well defined as in the Atlantic coast States. Cumulus clouds frequently precede showers in summer, and in winter snow is often preceded by cirro-cumulus clouds.

South to southwest winds prevail during periods of abnormal heat and northwest to north winds during periods of abnormal cold.

Frost is likely to injure fruit or other crops from April 20 to May 25, and from August 20 to September 15. In all seasons frost is generally preceded by rising, or high stationary barometer, temperature 41° to 54° at the morning and 50° to 58° at the evening observation of the preceding day; relative humidity high at the preceding morning and low at the preceding evening observation; wind northwest to northeast; and generally clear weather at the observation of the preceding evening.

DETROIT, MICH.

Precipitation is usually preceded ten to twelve hours by southeast to southwest winds. In summer the barometer generally falls to 29.80 before rain begins, in spring and autumn to 29.85, and in winter to 29.90. In spring rain begins with falling barometer, just after the turn from rising to falling; in summer with stationary or falling barometer; and in autumn and winter with falling barometer. Snow flurries or light showers sometimes occur twelve to twenty-four hours after the barometer begins to rise during clearing weather. A rapid fall in the barometer with east to south winds immediately precedes precipitation. When the barometer rises slowly precipitation usually continues until the barometer reaches 29.95; in winter, however, the weather will clear shortly after the barometer begins to rise, especially if the pressure has been quite low.

During the summer months the relative humidity has been observed to be abnormally low ten to fourteen hours before thunderstorms, especially in the afternoon when thunderstorms occur the following morning. In all other seasons no connection has been noted between atmospheric moisture and approaching precipitation.

The only special rain indication noted in connection with clouds is a peculiar formation of cirro-cumulus clouds during spring, autumn, and winter, when clouds of this class that present a creamy appearance indicate rain or snow within about twelve hours. In spring, autumn, and winter cirro-cumulus clouds at night in long lines, frequently with

halos, indicate rain or snow. The movement of these clouds is usually moderately rapid. Cirrus and cirro-stratus clouds move from the west, but the interval between their appearance and the beginning of precipitation has not been observed.

The high winds of spring are from northeast with falling barometer, and from southwest to west with low and rapidly rising barometer; of summer from southwest with rising barometer; of autumn from southwest to west with rapidly rising barometer; and of winter from northeast to east with rapidly falling barometer, and from southwest to west with rapidly rising barometer.

During periods of abnormally high temperature the winds are usually from south to southwest. In spring the cold winds are from northwest to northeast, in summer from northeast to east, in autumn from west to northwest, and in winter from southwest to west, and on rare occasions, from the northeast.

Frost is likely to damage fruit or other crops from April 15 toMay 15, and from September 1 to 20. Frost is usually preceded by barometer above 30 and rising, an indicated temperature fall to between 30° and 35°, relative humidity 70 to 75 per cent; in spring northwest to northeast winds, cumulo-stratus moving rapidly in the afternoon, and evening clear; in autumn light westerly winds and no clouds.

DODGE CITY, KANS.

In all seasons precipitation is generally preceded ten to eighteen hours by southeast to northeast winds and falling barometer, and precipitation begins on or after the turn of the barometer from falling to rising. As a rule the barometer falls to about 29.85 in spring and summer to 29.90 in autumn, and to about 30.05 in winter before precipitation begins.

The observer has not noted the relation, if any, that exists between atmospheric moisture and approaching precipitation.

Cirrus and cirro-stratus clouds move from the west, but the observer has not noted the extent to which they forerun precipitation. Clouds moving rapidly from the southwest when the barometer is on the turn from rising to falling have been observed to precede rain.

The warm winds of spring and summer are from southeast to southwest, and of autumn and winter from southeast to south. In spring the cold winds come from the north and northwest, and during the balance of the year from northeast to northwest.

Frost is most likely to damage fruit or other crops in April and May. Heavy frost is usually preceded by rising barometer, low humidity, few clouds, and light west to northwest winds.

DUBUQUE, IOWA.

Southeast winds and falling barometer precede precipitation twelve to twenty-four hours in spring and autumn, and often for a period of forty-eight hours in winter. In summer southerly winds usually precede rain about twelve hours, and rain begins on the turn of the barometer from falling to rising. In all seasons the barometer generally falls to 29.90, or below, before precipitation begins.

An increase or decrease in relative humidity has not been observed to precede precipitation, except in winter, when an increase in atmospheric moisture, with rising temperature, is a sure indication of precipitation.

Cirrus or cirro-stratus clouds moving from the west forerun precipitation about twelve hours in spring and autumn, and twenty-four to forty-eight hours in winter. In summer cirrus or cirro-stratus clouds seldom appear. The most common forms of clouds that presage rain in spring and autumn are hazy cirro-stratus in spring and autumn, cumulus and cumulo-stratus in summer, and thickening stratus in winter.

The warm winds of this locality are from south to southeast in spring, autumn, and winter, and from south to southwest in summer. The cold winds of all seasons are from west to northwest.

Frost is most likely to damage fruit or other crops in the latter part of April, in May and September and early in October. Heavy frost is generally preceded by low and rising barometer, falling temperature, high and decreasing relative humidity, and clearing weather.

DULUTH, MINN.

Precipitation is usually preceded fourteen to eighteen hours by northeast winds in spring, summer, and autumn, and by southerly winds in winter. The barometer generally falls to 29.90 in summer and autumn, to 30 in spring, and to 30.05 in winter before precipitation begins. In summer with northeast surface winds, clouds before and during rain are frequently from the southwest.

The relative humidity generally increases ten to fifteen hours before precipitation begins to 80 per cent, or above, in spring and winter, and to 85 per cent, or above, in summer and autumn.

Cirrus or cirro-stratus clouds moving from the west in spring, summer, and winter, and from west to northwest in autumn generally precede precipitation about thirty-six hours and, occasionally, three to five days. Cirrus, cirro-stratus, cirro-cumulus, and alto-stratus from westerly and northerly directions in all seasons usually indicate precipitation within six to forty-eight hours (low and high average). Sometimes only a narrow band of cirro-cumulus is an excellent index of rain, especially in summer. In spring and autumn lower clouds from

southerly to northeasterly presage rain; in summer heavy cumulus, strato-cumulus, or stratus in the west or southwest, or moving from southwest or northeast, indicate rain; in winter dull, lead-colored stratus or strato-cumulus clouds from a southerly direction, or from northeast, when the lake is open, forerun precipitation. Lunar halos are generally followed by precipitation in eighteen hours, and solar halos in about twenty-four hours on an average.

In all seasons the warm winds are from southwest, except in December, when abnormally high temperature sometimes has surface winds from the northeast. During periods of abnormally low temperature the winds are northeast to southeast in spring and autumn, northeast in summer, and west to northwest in winter.

Frost is most likely to damage fruit or other crops from May 15 to September 25. Heavy frost is usually preceded by increasing and low barometer, relative humidity, low, and increasing from about 50 to 95 per cent, decreasing southwest and north winds, temperature falling to 38° or below, and clearing or clear weather.

EASTPORT, ME.

South to east winds usually precede precipitation about twelve hours, and precipitation generally begins when the barometer has fallen to 29.85 or below.

An increase in relative humidity occurs several hours before precipitation, and 80 to 90 per cent of relative humidity indicates an early beginning of precipitation.

Cirrus or cirro-stratus clouds moving from the west often precede precipitation ten to fourteen hours in spring, summer, and autumn, and six to eight hours in winter. The clouds thus observed move rapidly and merge into stratus.

The high winds of spring and winter are from easterly with falling, and from westerly with rising, barometer; in summer and autumn high east to south winds occur with falling, and high westerly winds with rising, barometer.

The warm winds of spring are from the southwest, of summer from westerly, and of winter from south to east. The cold winds of spring are from northwesterly, of summer and autumn from south to east, and of winter from northerly.

Frost is most likely to damage crops during the latter half of April and in September. Heavy frost is usually preceded by high barometer, falling temperature, low relative humidity, and light northerly winds.

ELKINS, W. VA.

In spring, autumn, and winter southwest winds and falling barometer precede precipitation twelve to twenty-four hours, and the barometer generally falls to 30 inches or below before precipitation begins.

Summer showers are often preceded by light and variable winds, and begin on the turn of the barometer from falling to rising.

While an increase in humidity was observed to precede precipitation during the autumn and winter of 1900–1901, it can not be said that high humidity indicates rain, as frequently the humidity is high during dry periods, especially in autumn, which is the season of minimum rain frequency.

During periods of abnormally high temperature the winds are generally from a southerly quarter. The cold winds of all seasons are from west to north.

While cirrus or cirro-stratus clouds moving from the west in spring, summer, and autumn, and from the southwest in winter, have been observed generally to precede storms and give place to lower clouds, these clouds are frequently followed by dry weather during autumn.

Frost is likely to damage fruit or other crops from April 1 to June 10, and during September and October. Heavy frost is usually preceded by high pressure. At the preceding 8 p. m. observation the temperature may be as high as 60°, and the dew point considerably above 32°. North to west winds decrease in velocity to calm. Absence of clouds appears to be a most important factor, as at this altitude loss of heat by radiation takes place rapidly.

EL PASO, TEX.

No special features regarding wind directions and movements of the barometer preceding rain have been noted by the observer. Franklin Mountain, which is about 1½ miles north of station, diverts north and south winds, especially south winds, to other directions, and the wind-direction records of the station are, therefore, reported as largely the product of local causes. High velocities, as shown by the local vane, are extremely rare, although high north winds prevail at times in the vicinity.

The extent to which the moisture of the air indicates precipitation has not been observed.

During periods of abnormal heat the prevailing winds are from the northwest in spring and winter, and from east or northwest in summer and autumn. The cold winds of spring and winter are also reported as coming from the northwest, while in summer and autumn they are from east to northeast. Wind directions are, however, untrue on account of causes above referred to.

Cirro-stratus clouds are sometimes observed moving from the southwest in summer and autumn, and from west to southwest in spring and winter. No relation has been locally observed, however, between these clouds and approaching precipitation.

Frost is likely to damage vegetation in the spring, after March 15. Actual frost is so extremely rare at this station that the conditions favorable to its occurrence can not be stated. The frost records are, in fact, those of freezing temperatures.

ERIE, PA.

In the colder months precipitation is preceded by winds from either the east or south quadrants. When winds set in steadily from the east quadrants with falling barometer precipitation quickly follows. When winds set in from south to southwest, during the colder months, with falling barometer precipitation usually follows in twelve to twenty-four hours. During the warmer months rain is usually preceded twelve to twenty-four hours by south to southwest winds and falling barometer, and the barometer generally falls to 29.90 or below before rain begins. Summer showers occur with the shift of the wind to southwest and on the turn of the barometer from falling to rising.

In spring and summer the relative humidity generally decreases twelve hours before rain begins, while in autumn and winter an increase in relative humidity is observed about twelve hours in advance of precipitation. The moisture of the air is not, however, a particularly good indication of precipitation at any season of the year.

The special characteristics of cloud formation, either of kind, direction, or of speed that presage rain at this station have not been noted by the observer.

During periods of abnormally high temperature the winds are from south to west. During periods of abnormally low temperature the winds are from west to northwest. The high winds at this station usually occur with falling barometer and come from a westerly direction.

Frost is most likely to damage fruit or other crops from April 15 to May 15.

ESCANABA, MICH.

In the spring precipitation is most frequently preceded by northeast to southeast winds and falling barometer. With freezing temperature snow will begin when the wind shifts to easterly, and about the time the barometer begins to fall. With temperature above freezing the barometer falls to 30 or below before rain begins. In summer showers are preceded by southerly winds and falling barometer, and rain begins when the wind shifts to westerly and the barometer is on the turn from falling to rising. The precipitation of autumn also occurs generally under the wind and barometer conditions noted for summer. In this season, however, precipitation is preceded by southeast winds and falling barometer, and the barometer usually falls to 29.90 or below before precipitation begins. In winter precipitation is preceded either by easterly or southerly winds and falling barometer. When by easterly winds and low temperature snow begins when the winds go into easterly and the barometer begins to fall. When by southerly winds precipitation usually begins when the barometer has

fallen to 29.95, or below, and is on the turn to rising, with wind shifting to westerly.

In spring, autumn, and winter there is generally an increase in relative humidity in advance of precipitation; in summer, afternoon showers usually follow high morning humidity.

In spring cirro-stratus clouds moving rapidly from the west indicate rain; the interval between the appearance of these clouds and rain is not, however, well defined. In summer cirro-stratus clouds moving from the west indicate rain within a few hours. In winter the movements of these clouds are seldom discernible. In spring when cirro-stratus are followed by alto-stratus rain soon begins; in summer cirrus soon change to alto-stratus and then to cumulo-nimbus when rain begins; in autumn cirro-stratus changes to alto-stratus and then to stratus.

Warm winds are from the southeast in spring, from southwest to south in summer, from southeast to south in autumn, and from south in winter. The cold winds of spring are from the north, of summer from north to north-northwest, of autumn from north to northwest, and of winter from northwest, decreasing and shifting to west.

Frost is liable to do damage late in the spring and early in the fall, but no fruit and very little farming produce is subject to injury, the principal industries of this section being lumbering and mining. In spring and autumn frost usually occurs with rising and high barometer, clearing weather, and low humidity.

EUREKA, CAL.

In spring, autumn, and winter southeast winds generally set in four to eight hours before rain begins. In June rain is preceded by northwest winds. As a rule no rain falls in July and August. In spring rain usually begins with the barometer about 29.90, and near the turn from falling to rising. In autumn and winter rain begins with the barometer about 29.95 and falling, or near the turn from falling to rising.

In the spring there is usually a decrease in relative humidity four to six hours before rain, and a rapid decrease four to ten hours before heavy rain. When, in this season conditions are normal, a sudden decrease in relative humidity to about 50 per cent generally indicates heavy rain, and 90 per cent of relative humidity, with clouds and high fog, is frequently followed by light rain. In autumn the relative humidity decreases two to six hours before heavy rain, but may either decrease or increase before light rain. When the humidity is very low, with cloudy weather, rain usually follows, and late in autumn steady, light rain usually falls with relative humidity, ranging from 75 to 90 per cent. In winter the relative humidity decreases four to

twelve hours preceding rain, although sometimes light rain is preceded two to six hours by an increase in humidity. In this season rain usually begins with relative humidity 80 to 90 per cent, although very low relative humidity and a marked depression of the dew-point indicates rain, or wind and rain.

Cirrus or cirro-stratus clouds are seldom observed, and when they do appear move from the northwest, and sometimes, in the summer, from the west. In spring alto-stratus clouds are observed a day or more before rain, and cumulo-stratus or stratus immediately precede rain; sometimes cirro-stratus change to alto-stratus before rain, and the latter move from a westerly direction. Similar cloud forms and movements are observed in autumn and winter, and also before the infrequent rains of summer.

The high winds of this locality are usually from the northwest, with rising or high barometer; in spring and winter the high winds may come from northwest to north. Warm winds come from southerly or southeast, and cold winds from the northeast.

Peaches and cherries are likely to be damaged by frost in March and April. In the spring heavy frost is usually preceded by barometer about normal and rising, temperature about normal and falling, relative humidity increasing during the night, calm or light winds, and few, if any, clouds; in winter by high or rising barometer, temperature falling below the normal, relative humidity about 80 per cent and increasing, and light northerly winds.

EVANSVILLE, IND.

Precipitation is generally preceded by southeast to northeast winds and falling barometer, and the barometer usually falls to 29.95 or below in spring, summer, and winter, and to 30 or below in autumn, before rain begins. In spring and winter rain begins on a falling barometer, and in summer and autumn on or after the turn in the barometer from falling to rising. In spring, autumn and winter rain winds set in thirty-six to forty-eight hours and in summer eighteen to twenty-four hours before rain begins.

In spring and summer the relative humidity increases and in autumn and winter it decreases before precipitation. In all seasons the average relative humidity preceding rain is 80 to 86 per cent.

The prevailing direction of cirro-stratus clouds is from west to northwest in spring, and from west in summer, autumn, and winter. In spring cirro-stratus clouds are forerunners of rain, and strato-cumulus clouds immediately precede rain. In summer cirro-stratus are followed by alto-cumulus and strato-cumulus clouds preceding rain. In autumn, cirrus, cirro-stratus, and strato-cumulus precede rain. In winter the upper clouds merge into alto-stratus and stratus preceding rain.

During periods of abnormally high temperature the winds are from south in spring and autumn, from south to southwest in summer, and from south to southeast in winter. The cold winds of spring and winter are from the north, of summer from the northeast, and of autumn from north to northeast.

Frost is likely to damage fruit or other crops in the spring after April 1, and in the fall before October 1.

In spring frost is likely to follow rapidly rising barometer, falling temperature, increasing humidity, northwest to north winds, and a few alto-cumulus and cirro-stratus clouds. In autumn heavy frost is preceded by rising barometer, falling temperature, increasing followed by decreasing humidity, northerly winds, and clear or clearing weather.

FLAGSTAFF, ARIZ.

In all seasons precipitation is preceded by falling barometer, and the barometer generally falls to 30, or below, before precipitation begins. In spring precipitation is preceded about twenty-four hours by southwest to west winds, in summer about twelve hours by northwest to north winds, in autumn about twenty-four hours by northwest to north winds, and in winter about twenty-four hours by south to southwest winds.

There is an increase in relative humidity before precipitation, and in summer the increase is observed forty-eight hours before rain begins.

In spring, summer, and autumn strato-cumulus clouds forerun precipitation, and in winter a similar formation appears before cumulo-nimbus.

During periods of abnormally warm weather the wind is from north to east in spring, from west to northwest in summer, from northwest to northeast in autumn, and from east to southeast in winter. During periods of abnormally low temperature the wind is from the southwest in spring, from southwest to west in summer, from the southwest in autumn, and from southwest to west in winter. Preceding precipitation the temperature falls in summer and rises in winter.

Frost is most likely to damage fruit or other crops in May and September.

FORT SMITH, ARK.

In the spring precipitation is preceded about twelve hours by south to southeast winds and falling barometer, and the barometer falls to 29.90, or below, before precipitation begins. In summer south to southwest winds and falling barometer precede rain about twelve hours, and the barometer falls to 29.85, or below, before rain begins. In autumn southeast to northeast winds and falling barometer precede rain eight to ten hours, and the barometer falls to 29.95, or below,

before rain begins. In winter precipitation is usually preceded six to eight hours by south to southwest winds and falling barometer, and precipitation begins when the barometer has fallen to 30, or below, and is on the turn from falling to rising.

In spring and summer the humidity is not a reliable indication of rain; an increase is, however, often noted in these seasons several hours before rain. Preceding rain in autumn the relative humidity increases with a warm southerly wind to about 85 per cent before rain begins. In winter the increase in relative humidity is very noticeable twelve hours in advance of precipitation.

In spring the more dense formation of cirro-stratus clouds are forerunners of rain, and they are observed moving from the west about six hours before rain begins. In summer rain is always preceded a few hours by cirro-stratus clouds moving from the southwest. In autumn, as in spring, rain is preceded by the denser formation of cirro-stratus clouds moving from the west. This is also true of the winter months, when the clouds appear about eight hours before precipitation begins.

During periods of abnormal heat the wind is from the south or southeast in spring and autumn, from the south in summer, and from the southwest in winter. The colder winds are from the northwest in spring, autumn, and winter, and from the west in summer. During the summer season the temperature preceding thundershowers, which is the form in which rains occur, becomes abnormally high about forty-eight hours in advance of rain. In spring, autumn, and winter precipitation is preceded about twelve hours by a gradual rise in temperature.

Frost is likely to damage fruit or other crops from about the middle of March through April and May. The general conditions that precede frost are as follows: In spring, high pressure, temperature about 45°, relative humidity about 30 per cent, and light northwest winds; in autumn the same as in spring, except that the relative humidity is about 40 per cent. Cirrus clouds of a fine texture are frequently noted before heavy frost.

FORT WORTH, TEX.

In spring and summer precipitation is preceded eight to fourteen hours by falling barometer and southerly winds, and the barometer generally falls to 30 or below before precipitation begins. In autumn southerly winds and falling barometer precede rain about eight hours, and the barometer usually falls to 29.85 or below and is on the turn from falling to rising before rain begins. In winter south to southeast winds usually precede precipitation, and precipitation generally begins after the turn in the barometer from falling to rising. In the case of storms that advance from northern Mexico or the Rio Grande Valley, however, precipitation is preceded by east to northeast winds,

and begins with falling barometer. Except in summer a steady decrease in the barometer indicates rain. In summer a fluctuating barometer also indicates rain.

An increase in relative humidity with easterly winds indicates rain in all seasons. When the winds are from directions other than easterly a decrease in humidity sometimes precedes precipitation. Changes in the moisture of the air do not necessarily indicate rain unless the wind is from an easterly quarter.

Cirrus or cirro-stratus clouds moving from the west are often observed ten to sixteen hours before precipitation. Lower clouds moving from north to northeast precede precipitation in spring and summer, from east to southeast in autumn, and from southeast in winter.

The warm winds of spring and summer are southerly, and of autumn and winter southwesterly. The cold winds of spring are from the northwest, of summer from the southeast, and of autumn and winter from the north.

Frost is most likely to damage fruit or other crops from March 15 to April 30, and from October 1 to November 30. In spring and autumn frost is preceded by high pressure, low temperature, low humidity, and clear weather; in winter by decreasing pressure, falling temperature, increasing humidity, light north to northeast winds, and clear weather.

FRESNO, CAL.

Southerly winds and, generally, falling barometer set in six to ten hours before rain begins, and the barometer falls to 29.90 or below before the beginning of precipitation.

There is usually a decrease in relative humidity four to six hours before rain, except during the prevalence of fog. The degree of moisture near the earth can rarely be used as an indication of approaching rain.

Cirrus clouds, moving from the west, with lunar halos occasionally precede rain two to three days in spring, autumn, and winter. Choppy, honeycombed alto-stratus clouds almost invariably precede normal rains in all seasons. These clouds have a rapid movement from a southerly direction. Local showers are usually preceded by cumulus and alto-cumulus clouds on the mountain ranges.

In all seasons the warmer winds are from east to northeast, and cold winds come from a northerly direction. The prevailing winds in all seasons are from the northwest.

Frost is most likely to damage fruit or other crops from December 10 to April 15. In winter and spring heavy frost is usually preceded by high barometric pressure, falling temperature, northerly winds, high humidity, and scattered cirrus clouds. No frost occurs in summer and autumn.

GRAND HAVEN, MICH.

In spring and winter precipitation is preceded twelve to twenty-four hours by south to southeast winds and falling barometer when storms are advancing from the west or northwest; when they come from the southwest precipitation is preceded by east to northeast winds and often begins shortly after the wind sets in from these directions. Heavy snow often occurs after the wind has shifted to west and northwest following the passage of a storm and with rising barometer. Summer rains are usually preceded by southerly winds and falling barometer and begin about the time the lowest barometer is reached, or on the turn of the barometer from falling to rising. Southwest storms are, however, occasionally the cause of rain in late summer and autumn and are preceded by the same general conditions that have been noted for spring and winter storms. Except in the case of southwest storms the barometer generally falls to 30, or below, before precipitation begins.

There is usually a decrease in relative humidity twelve to twenty-four hours before precipitation begins, and an increase just before it begins, especially during the warmer months. Continued high relative humidity, unless due to fog, continued unsettled weather with rain, and clearing weather rapidly follow a decrease in relative humidity.

In spring precipitation is often preceded by cirro-stratus clouds moving from the northwest, which merge into stratus. During summer and early autumn rain is generally preceded by cirro-stratus or alto-stratus clouds twelve to twenty-four hours, which change to cumulus and cumulo-nimbus, nearly all precipitation during these seasons being in the form of thunder storms. In late autumn and winter stratus clouds prevail.

In the warmer months high winds occur with falling barometer from a southerly quarter, and with a rising barometer later when the wind shifts to west and northwest. During the colder months high southerly and southeast to northeast winds occur with a falling barometer, and high southwest to north winds with a rising barometer.

The warm winds of spring and autumn are from southeast to southwest, and of summer and winter from the southwest. The cold winds of spring come from the north, of winter from the northeast, and of summer and autumn from the northwest.

Frost is liable to damage fruit or other crops in spring after May 1, and in autumn from September 15 to October 15. Heavy frost is generally preceded by a rapid clearing of the sky toward evening, increasing or high pressure, increasing or high relative humidity, temperature falling to at least 36°, and wind diminishing to light and generally from the northeast.

GRAND JUNCTION, COLO.

The prevailing winds at this station are from the northwest in spring, summer, and autumn, and from southeast in winter. Precipitation is generally preceded by steadily falling barometer, and begins on the turn of the barometer from falling to rising. It appears that precipitation begins after an area of low barometer has passed and with the approach of the succeeding area of high barometer. As many low areas pass over this locality without precipitation no invariable rule can, however, be laid down. The barometer usually falls to 29.90 or below in spring and autumn, to 29.85 in summer, and to 30 or below in winter before precipitation begins. Owing to the topography of the section, and to the small amount of precipitation, it has not been possible to determine the ruling direction of "rain" and "dry" winds.

Beyond the fact that there is a slight increase in relative humidity before precipitation, the extent to which the moisture of the air indicates rain has not been observed; neither has there been any special attention paid to clouds, their formations and characteristics, in connection with precipitation, beyond the fact that cirrus clouds move from a westerly direction.

During periods of abnormally high temperature the wind is usually from the southeast; the direction of cold winds in autumn and winter is also given as southeast, while those of spring and summer are from the northwest.

Frost is most likely to damage fruit or other crops from April 1 to May 15. Heavy frost is preceded by rising barometer, wind shifting to northwest, temperature about normal, and relative humidity about or slightly above normal.

GREEN BAY, WIS.

In all seasons precipitation is preceded by falling barometer, and the barometer falls to 29.90 or below before precipitation begins, except in winter, when precipitation often begins with the barometer about 29.95 to 30. In spring and autumn precipitation is generally preceded by southeast winds, in summer by southeast to southwest winds, and in winter by southeast to northeast winds, the winds setting in from these directions twelve to twenty-four hours before precipitation begins.

In spring and winter there is a slight decrease and in summer and autumn a slight increase in relative humidity before precipitation, the changes being noted for a short period only before the beginning of precipitation.

Beyond the fact that cirrus clouds move from the southwest and

west, no note has been made of characteristic cloud forms that precede precipitation at this station.

The warm winds of all seasons are from the south. The cold winds of winter and spring are from the southwest, of summer from the north, and of autumn from the west.

Frost is likely to damage fruit or other crops after May 15 and before September 20. Heavy frost is usually preceded by high barometer, moderately low humidity, northerly winds, and clear weather.

HANNIBAL, MO.

In spring and winter precipitation is generally preceded one to two days by east to south winds and falling barometer. In summer the same general conditions of wind and barometer precede rain, except in the case of showers and thunderstorms, when rain begins about or after the turn in the barometer from falling to rising. Autumn rains are usually preceded one to two days by easterly winds and falling barometer. In spring, summer, and autumn the barometer falls to 29.90 or below, and in winter to 30 or below, before precipitation begins. Rapidly falling barometer during the night or forenoon, and often in the afternoon, indicates rain, and the earlier the fall begins during the day the more certain rain will occur in twelve to twenty-four hours. A decided rise after such a fall indicates clearing weather.

The relative humidity usually increases, but sometimes decreases, six to twelve hours in advance of rain.

Cirrus and cirro-stratus clouds usually precede precipitation during late fall, winter, and early spring, and cumulus clouds usually precede rain during late spring, summer, and early fall. In spring and winter the prevailing direction of cirrus clouds is from west to southwest, and in autumn from the west. Cumulus clouds just above the western horizon precede thunderstorms, and the earlier they appear in the morning the more certain it is that local showers or thunderstorms will occur in the afternoon or evening of the same day; while if they do not appear until the middle of the forenoon or toward noon thunderstorms may not occur for a day or two, especially if the altitude of the clouds is great.

South to southwest winds prevail during periods of abnormal heat. The cold winds of spring are from northwest to northeast, of summer from northeast, and of autumn and winter from northwest to north. During the colder months a rapid rise in temperature after a cold period is usually followed by precipitation.

Frost is most likely to damage fruit or other crops from April 15 to May 31 and from September 1 to October 10. Heavy frost occurs with high barometric pressure, temperature near the freezing point, humidity above the normal, and light north to west winds. Heavy frost may occur with humidity below the normal.

HARRISBURG, PA.

In all seasons precipitation is usually preceded about twenty-four hours by east to south winds and falling barometer, and the barometer generally falls to 30 or below before precipitation begins. Summer showers, as a rule, begin on or after the turn in the barometer from falling to rising.

An increase in relative humidity is observed six to twenty-four hours before precipitation; on the approach of thunderstorms the relative humidity increases until the storm begins, then decreases rapidly, and increases again after the storm. Heavy frost is often followed by rain within eight to thirty-six hours.

Cirrus and cirro-stratus clouds generally indicate precipitation, and are observed moving from the west eighteen to twenty-four hours before precipitation begins. After a period of fine weather cirrus clouds are usually the first indication of an approaching storm. Cirro-stratus clouds, or clouds of a halo-forming character, indicate rain about two times in five. A low bank of dark clouds along the western horizon at sunset is nearly always followed by rain before sunrise the next morning, and generally before midnight.

Frost is likely to damage fruit or other crops from April 1 to May 10. In spring and autumn heavy frost is preceded by stationary and high barometer, falling temperature, low relative humidity, and clear or partly cloudy weather. In winter the same conditions obtain except that the relative humidity is usually high.

HAVRE, MONT.

Precipitation is preceded by falling barometer and northeast winds, and begins about the time the barometer is on the turn from falling to rising. A falling barometer, with marked oscillations, is followed by precipitation, and a sudden and marked fall in the barometer below and continuing below the normal indicates rain or snow. The period that elapses between the time the wind sets in from the northeast and rain or snow begins varies from about twelve hours to several days, the period being longer, as a rule, in the warmer months.

The expression "It feels like rain" is especially applicable to the climate of this section, and many rains are preceded by a "softness" of the atmosphere which may be due to increased humidity.

Cirro-stratus clouds are, to an extent, forerunners of rain. In autumn and winter cirro-stratus clouds that produce well-defined halos are often observed moving from the west twelve to twenty-four hours in advance of precipitation. The cirro-stratus are the only clouds that appear to presage precipitation before the rain-bearing clouds actually appear.

In the colder months precipitation begins with rising temperature,

and in the warmer months rain begins with falling temperature or with temperature on the turn from rising to falling.

During periods of excessive or unseasonable heat the prevailing winds are from the southwest. The cold winds of spring are from the northeast, of summer from the north, and of autumn and winter from the north.

Frost is likely to damage crops from June 1 to August 15. The conditions favorable to the occurrence of heavy frost are barometer above the normal, temperature about 36°, humidity low, clouds, if any, dissipating, and wind light.

HELENA, MONT.

The heavy rains of May and June are usually preceded twelve to twenty-four hours by northeast to east winds and falling barometer; they sometimes begin on a falling barometer, but generally after the turn in the barometer from falling to rising. In summer southwest winds precede rain twelve to thirty-six hours, and in autumn and winter precipitation is preceded about twelve hours by southwest to northwest winds; in these seasons also the barometer falls before precipitation, but precipitation seldom begins until after the turn from falling to rising barometer. In winter the barometer generally falls to 29.90 or below before precipitation begins; in the other seasons the depression of the barometer preceding precipitation is greater.

Generally no rain accompanies a "chinook" condition, except possibly a very light shower at the beginning. "Chinooks" generally occur on a rapidly rising barometer, or on a rapidly fluctuating barometer; these conditions indicate cloudy weather without rain. An area of low barometer over Idaho or Utah on the western slope with an area of high barometer moving southward along the eastern slope indicates a decided fall in temperature and heavy snow, especially during the autumn.

Very little relation has been observed between atmospheric moisture and rain, and in summer the atmosphere is often very dry during the twenty-four hours preceding precipitation.

No relation has been observed between cirrus and cirro-stratus clouds and rain. Cirrus clouds are generally observed moving from a westerly direction, with an inclination to move from the south of west in summer and from north of west in winter. Cirrus and alto-stratus clouds, when in a well-defined bank, indicate the approach of an area of low barometer, or storm. In winter cold waves are indicated by the lower clouds. Streams of fog will often be seen pouring down the ravines and canyons 25 miles to the northward twelve to twenty-four hours before snow at Helena. In spring, autumn, and winter alto-stratus, cumulus, and stratus clouds all indicate precipitation when other conditions are favorable. In summer cumulus clouds are forerunners of showers.

The warm winds of all seasons come from the southwest, and the cold winds of winter from north to northwest. Chinook conditions during the summer are of short duration, and when they occur are accompanied by lower temperature instead of higher, as in winter.

Frost is likely to damage vegetation from April 1 to May 30, and from August 15 to September 30. Heavy frost is preceded by high barometric pressure, temperature below 36° at 8 p. m., dew-point near 32°, clear weather, with very light wind or a calm.

HURON, S. DAK.

Precipitation is preceded twelve to twenty-four hours by southeast to east winds and falling barometer, and in spring, summer, and autumn begins when the barometer has fallen to 29.90 or below, and about the time of the change from falling to rising barometer. In winter precipitation sometimes begins some hours before the barometer reaches its lowest reading, and at other times it begins on or after the turn from falling to rising; in this season precipitation seldom begins before the barometer has fallen to 30 or below. Rain or snow that occurs with rapidly rising barometer is usually of short duration. Slowly falling barometer, with wind backing from southeast to east and northeast (storm center in the west or southwest and high pressure in the northeast), almost invariably indicates precipitation, especially in spring and autumn, and some of the heaviest rain and snow storms are preceded by these pressure conditions. A steady southwest wind indicates clearing or continued fair weather.

In spring there is usually an increase in relative humidity six to twelve hours before precipitation, especially in cases where the precipitation continues long. Before summer showers, when the temperature is high and increasing, the relative humidity decreases; at other times the relative humidity increases before summer rains. Autumn rains are generally preceded six to twelve hours by increasing relative humidity, especially in the cases of rains that occur late in the day or at night. With abnormally high temperature winter precipitation is preceded six to twelve hours by increasing relative humidity.

In the spring the prevailing movement of cirro-stratus clouds is from northwest to southwest, northwest predominating; in summer and autumn from southwest to west, southwest being most frequent; and in winter from northwest to west, northwest being the direction most frequently noted. In instances where these clouds are followed by precipitation, rain or snow occurs six to twelve hours after their appearance. In spring, autumn, and winter cirro-stratus and alto-stratus nearly always precede rain or snow, but are often present when no rain or snow occurs. In summer cirro-stratus and strato-cumulus nearly always precede rain, but often appear when no rain follows.

Warm winds are from south to southeast; the "hot winds" of summer are, however, usually most intense with wind veering from south to southwest. The cold winds of winter come from northwest, veering to north.

Fruit and vegetables are likely to be damaged by frost from April 20 to September 20; wheat, oats, barley, and rye from May 1 to August 1; corn and flax from May 1 to September 20. Heavy frost is preceded by high barometer, low evening humidity, with temperature about 50° and falling, northerly winds becoming light, and clear or clearing weather.

INDEPENDENCE, CAL.

In spring, autumn, and winter precipitation is preceded ten to twenty hours by south winds and falling barometer, and the barometer falls to about 29.80 inches in spring and autumn, and becomes stationary before precipitation begins. In winter precipitation begins with the barometer about 29.80 and falling. In summer rain is preceded by southeast winds and begins when the barometer has fallen to about 29.80 and is stationary.

There is almost invariably a decrease in relative humidity two to twelve hours preceding rain, a few exceptions being noted in July, August, and September. On account of the peculiar configuration and topography of the country 100 miles to the north and south, together with the desert-like character of the entire valley, broken here and there only by very limited oases, the air is extremely dry up to the beginning of precipitation, and the rains are paradoxically called by the inhabitants "dry rains." The housewives do not take in their wash clothes from the lines on account of a rain storm, knowing by experience the rapidity of evaporation even during the time precipitation is falling. This is true of all storms, except the Sonoras, when the whole valley is filled with moisture-laden clouds. The Sonoras occur too seldom to furnish material for investigation.

Cirrus or cirro-stratus clouds moving from the northwest are sometimes observed two to three days before precipitation. Stratocumulus clouds moving from the west and south in spring, from the south in summer and autumn, and from the southwest in winter precede precipitation.

The warm winds of all seasons blow from the northwest, and also the cold winds, except in summer, when the cool winds are from the southeast. In fact northwest winds prevail, except preceding precipitation.

Fruit or other crops are likely to be damaged by frost from September 21 to October 30, and from March 18 to May 28. In the spring almonds, apricots, and early blossoming fruit, particularly almonds, apricots, and very early vegetables, are frequently damaged, none totally, however, and peaches are occasionally injured. In the fall late-maturing vegetables, such as tomatoes, peppers, potatoes,

late corn, and water melons, are subject to slight damage. In spring and autumn heavy frost is preceded by high and stationary barometer, low variable temperature, low humidity, cirro-stratus clouds, and north to northwest winds, and generally occurs after rain.

ITHACA, N. Y.

In spring, summer, and autumn precipitation is preceded twelve to forty-eight hours by southeast winds and falling barometer, and the barometer generally falls to 29.90, or below, in spring and summer, and to 29.95, or below, in autumn before precipitation begins. In winter southerly winds precede precipitation, but the winds shift more quickly and the signs of precipitation are not so well defined as in other seasons; precipitation begins in this season with a falling barometer and when the barometer has fallen to 30 or below. On account of the position of this station on the hillside and above the lake, diurnal winds are noticeable, especially during the warmer months. When not influenced by passing storms these winds come as a gentle east to southeast breeze by night and by day a northwest wind having a velocity two or three times greater than the day breeze. When, instead of shifting to the northwest in the early morning, the wind continues from the southeast and begins to increase in force, the approach of a storm is indicated. While rain begins most frequently with falling barometer, the heaviest rainfall often comes, especially in the warmer months, after the turn in the barometer from falling to rising.

Richard's registering hygrometer shows that in spring and summer the humidity sometimes decreases before rain but increases rapidly after rain begins; in spring rain begins with relative humidity from 50 to 98 per cent, and in summer it may be as low as 50 per cent one hour before rain begins. In autumn the effect of day and night seems greater than the influence of passing storms, and rain will begin with relative humidity as low as 50 per cent one hour before rain. In winter there is usually an increase in humidity from one-half to four hours before rain, and dry snow will begin with relative humidity as low as 40 per cent.

Cirrus clouds are a reliable indication of precipitation in all seasons, but are liable to be obscured by lower clouds of local formation in the colder portion of the year. These clouds appear moving from the west in spring and winter, from the northwest in summer, and from the southwest in autumn, twenty-four to thirty-six hours before precipitation begins. Special characteristics of clouds have not been noted except in connection with cirrus clouds.

Frost is likely to damage fruit or other crops in May and September. Heavy frost is generally preceded by high barometer, low temperature and humidity, very light wind and clear weather.

In spring rain is generally preceded twenty-four to thirty-six hours by southwest winds and falling barometer, and rain begins with rising barometer or when the barometer is on the turn from falling to rising. Summer rains are most frequently preceded by southerly winds and begin after the turn in the barometer from falling to rising. In autumn and winter rain is usually preceded twenty-four to thirty-six hours by northeast winds and begins while the barometer is falling or is on the turn from falling to rising. In all seasons the barometer generally falls to 30, or below, before rain begins. In summer conditions are rather sluggish and are sometimes negative in character, except two to six hours before thunderstorms when the barometer falls rapidly. During the late summer and in autumn the barometer fluctuates, rising and falling, several days in advance of the arrival of tropical storms.

There is usually an increase in atmospheric moisture twenty-four to thirty-six hours in advance of rain, the period being greater in winter than during the other seasons.

Cirro-stratus clouds usually move from southwest to west, and in summer are sometimes observed moving from the northwest. Rain follows the appearance of upper clouds in 48 per cent of the cases noted in spring, in 77 per cent of the cases in summer, in 61 per cent of the cases in autumn, and in 64 per cent of the cases in winter. Aside from the upper clouds no special characteristics of cloud formation, either of kind, direction, or speed that presage rain have been made a subject of observation at this station.

During periods of abnormally high temperature the wind is from south to southwest, except in autumn, when it is from northeast to southeast. During periods of abnormal cold the wind is from north to northwest in spring, from northeast in summer and autumn, and from west to northwest in winter. During winter abnormally high temperature is quite certain to be followed by rain within thirty-six hours. In summer high midday temperatures are followed by thunderstorms in the afternoon, and thunderstorms may be expected also when a twenty-four-hour temperature change of 4° to 6° is indicated.

Frost is most likely to damage fruit from November 1 to April 10. In spring the general conditions that precede heavy frost are, barometer usually below 30, slowly rising temperature, low humidity, and light west to north wind. In autumn the heaviest frosts occur with stationary or slowly rising barometer, with wind veering during the day to northeast and backing early in the evening to north and northwest. Sometimes the wind veers to east and south, returning to west early in the evening. The easterly winds bear moisture and hence result in heavy frost. Frost is rarely heavy with the coldest weather;

the air is too dry. (It is difficult to reconcile the observer's statements of "low humidity" and "of moisture bearing easterly winds preceding heavy frost.")

JUPITER, FLA.

In spring rain is generally preceded about twelve hours by southerly winds and falling barometer, in summer about twenty-four hours by northeast to southeast winds, in autumn about twelve hours by northeast winds, and in winter about six hours by easterly winds. In summer rain begins when the barometer is near the highest or lowest point, except when tropical storms are approaching, when the barometer falls. In autumn the barometer falls slowly before and rises rapidly after rain. In winter rain begins shortly after the barometer begins to fall, with easterly winds.

In all seasons the relative humidity decreases twenty-four to thirty-six hours before rain, and increases during the twelve hours preceding the beginning of rain. Unusually high or low relative humidity indicates approaching rain in about 50 per cent of the cases noted.

Cirro-stratus clouds move from the west in spring and winter and from the southwest in summer and autumn. In spring the upper clouds appear to bear very little relation to rain. In summer and autumn cirrus clouds indicate, to a small extent, conditions favorable to thunderstorms. In winter cirrus clouds, and stratus clouds moving from southeast to south, indicate rain.

The high winds of spring come from the northeast with rising and from the southeast with falling barometer; of summer from west to north with rising and from southeast to southwest with falling barometer; of autumn from southwest to northwest with falling barometer; and of winter from southwest to northwest with rising barometer.

During periods of abnormally high temperature the wind is from the southeast to south in spring, from southwest in summer, from east to southeast in autumn, and from south in winter. During periods of abnormally low temperature the wind is from northwest in spring and autumn, from north to northeast in summer, and from northwest in autumn.

Frost is destructive to the fruit and vegetable interests of this section, but the greatest damage results from frosts that occur in the spring. The general conditions that precede heavy frost are rapidly rising barometer, after an area of low barometer has passed, falling temperature for thirty-six to forty-eight hours, dew-point below 40°, diminishing west to north wind, and clear weather.

KALISPELL, MONT.

In spring and summer precipitation is preceded six to eight hours by southeast winds and falling barometer, and the barometer falls to 29.85 or below and begins to rise before precipitation begins. In

autumn and winter precipitation begins some hours after the wind has shifted to west or northwest and after the turn in the barometer from falling to rising. After precipitation begins the barometer again falls.

The relative humidity increases, on an average, nineteen hours in spring, twenty-one hours in summer, nine hours in autumn, and twelve hours in winter, respectively, before precipitation begins. In spring and summer there is usually a heavy deposit of dew before precipitation, and in autumn and winter hoar frost precedes precipitation.

Cirro-stratus clouds moving from the west are observed sixteen to twenty-four hours before precipitation. In spring and summer large cumulus or cumulo-nimbus about 20 miles southeast of station usually result in rain in this valley within twenty-four hours; clouds of this description begin to form between 9 and 11 a. m.

During periods of abnormally high temperature the wind is from the northwest in spring, summer, and autumn, and from south to southwest in winter. The cold winds of spring are from the west, of summer from the southeast, and of autumn and winter from the northwest. The high winds of all seasons come from the southwest, with rising barometer.

Frost is likely to damage fruit from May 15 to July 10, and grain from June 25 to August 1. Heavy frost is usually preceded by increasing barometer or barometer stationary and above 30, falling temperature, increasing humidity, southerly veering to light west and northwest winds, and decreasing cloudiness.

KANSAS CITY, MO.

With storms moving from southwest to northeast precipitation begins with falling barometer. Circular areas of low barometer the centers of which do not pass below central Nebraska and Iowa are seldom accompanied by rain at this station. Trough-shaped low areas usually produce precipitation on the turn of the barometer from falling to rising. In winter when a well-marked area of high barometer with low temperature crosses this section snow occurs soon after the barometer begins to fall, then ceases for a time, to begin again, possibly, on the succeeding rise in the barometer. In spring and autumn precipitation is preceded one to two days by southeast and in winter for about one day by east to southeast winds. In summer an oscillating barometer indicates a probability of thunderstorms. In all seasons a rapid fall in the barometer indicates early precipitation. Generally speaking the barometer falls to 29.90 or below in spring and autumn, to 29.85 or below in summer, and to 30 or below in winter before precipitation begins.

In spring and winter there is a decrease to a low percentage of relative humidity one to two days before precipitation; in summer

and autumn the decrease is sudden twelve to thirty hours before precipitation. As an indicator of precipitation the moisture of the air is uncertain and unreliable.

Cloud aspects are misleading. Occupying, as this station does, a midcontinental position, the clouds belonging to the various cyclonic areas appear, but whether or not precipitation will follow depends on the course and intensity of the storms and the character of the season. Cirrus and cirro-stratus clouds are so frequent that the times they are followed by rain form a small percentage of the times they are observed. These clouds advance from the west in spring, from southwest to west in summer and autumn, and from west to northwest in winter. In late spring, summer, and early autumn cumulus clouds in the early morning and large cirro-cumulus during the day presage rain. In winter small cirro-cumulus clouds moving from the southwest presage, to a greater extent than any other kind of clouds, rain or snow.

During periods of abnormal heat the wind comes from southeast to southwest; the cold winds of spring and winter are from the northwest to north, and of summer and autumn from northwest to northeast.

Frost is likely to damage fruit and vegetables late in the spring, and corn and late vegetables during autumn. Heavy frost is preceded by rising barometer, temperature falling to 38° or below, light north to west winds, and a clear sky.

KEOKUK, IOWA.

In spring, autumn, and winter precipitation is preceded twenty-four to forty-eight hours by east to south winds and falling barometer. In summer the winds that precede showers come from south to southwest. The barometer usually falls to 29.90 or below before precipitation begins, except in winter, when rain or snow often begins when the barometer has fallen to about 30. A slow fall of the barometer for forty-eight to seventy-two hours indicates precipitation; a slow rise in the barometer indicates clearing and settled weather. Rapid changes in the barometer indicate early changes in the weather.

The relative humidity generally decreases about twelve hours before rain, except in winter, when it increases, and a marked decrease in relative humidity in the evening is an indication of rain in spring, summer, and autumn.

In spring cirro-stratus clouds moving from the west appear twenty-four hours before rain. In summer cirro-stratus clouds move from the southwest, and rain is preceded by increasing cumulus changing to cumulo-nimbus clouds. In autumn cirro-stratus clouds moving from the west appear twenty-four hours before rain and change to alto-stratus and then to stratus before ran begins. In winter cirro-stratus

move from the northwest, and cirro-cumulus clouds appear twenty-four hours before snow. Cirro-stratus or alto-stratus moving from southwest or west and banking in the southwest or west presage precipitation. Cirrus clouds are observed during clearing weather following storms.

During periods of abnormally high temperature the wind is from south to southwest, except in winter, when it is from southeast to south. The cold winds of all seasons are from the northwest.

In September heavy frost is damaging to fruit and, if early in the month, to corn. Heavy frost is preceded by pressure above the normal, temperature falling during the evening, relative humidity between 45 and 50 per cent, light west to northwest winds, and few clouds or clear weather.

KITTY HAWK, N. C.

In spring rain is preceded one to two days by southwest winds and falling barometer, in summer one to three days by southerly winds, in autumn by northeast winds, and in winter by southeast winds. In spring rain usually begins when the barometer has reached its lowest reading, in summer on the turn in the barometer from falling to rising, in autumn, with northeast winds, soon after the turn in the barometer from rising to falling, and in winter on a falling barometer. Except with northeast winds in the autumn rain usually begins when the barometer has fallen to 30 or below in spring, summer, and autumn, and to 29.90 or below in winter.

There is an increase in relative humidity before rain, the increase being most marked in summer and winter. Much moisture at night, especially, indicates rain in from one to three days.

Cirro-stratus or cirrus clouds are sometimes observed moving from the southwest about twelve hours before rain in spring, from the south twenty-four hours before rain in autumn, and from the southwest five to eight hours before rain in winter. In summer upper clouds moving from the southeast are sometimes observed before rain.

The high winds of spring generally come from the southwest with a falling barometer, of summer from the northeast with a rising barometer, of autumn from the southeast with a falling barometer, and of winter from the northwest with a rising barometer. During periods of abnormally high temperature the wind comes from the southwest in spring, from west to southwest in summer, from south in autumn, and from south to southeast in winter. The cold winds of spring and winter come from the northwest, of summer from the north, and of autumn from the northeast.

Frost is likely to cause damage from April 10 to 30 and from October 10 to 31. Heavy frost is preceded by high barometer, temperature nearly to freezing, diminishing and light north to northwest winds, with clear weather, or a few fleecy clouds.

KNOXVILLE, TENN.

The winds at this station are prevailingly from the southwest during the spring, summer, and winter, regardless of rainfall or temperature changes. Numerous exceptions to this rule can be found, but there is no harmony among the exceptions, and no rules can be formulated. In all seasons precipitation is generally preceded by falling barometer, and the barometer falls to 30 or below in spring, summer, and autumn, and to 30.05 or below in winter before precipitation begins. In nearly all cases where precipitation begins with rising barometer it occurs in the form of light snow or light rain preceding a cold wave in winter, or a thunderstorm in summer. Immediately before clearing weather the barometer usually rises.

No particular relation between the moisture of the air and precipitation has been noted. The records of humidity at this station are too deficient to furnish satisfactory information concerning this subject.

Cirrus clouds, followed by cirro-stratus, are frequently followed by rain within twenty-four to thirty-six hours in the fall, winter, and spring, and within a few hours in summer. These clouds usually come from the southwest or west.

Frost is likely to damage fruit or other crops from March 15 to April 30 and from September 15 to November 30. Heavy frost is usually preceded by high barometric pressure, low temperature, low humidity, quiet winds, and an absence of clouds.

LA CROSSE, WIS.

In spring, summer, and autumn precipitation is preceded twelve to twenty-four hours by south to southeast winds and falling barometer, and in winter by northeast to southeast winds and falling barometer. In all seasons the barometer generally falls to 29.90 or below before precipitation begins.

There is usually an increase in relative humidity twenty-four to forty-eight hours before precipitation; at times, however, a decrease in relative humidity has been noted before rain. As the humidity is observed but once in each twenty-four hours, little weight can be given to the results obtained.

Cirrus or cirro-stratus clouds moving from the northwest are sometimes observed thirty-two to forty-eight hours before precipitation. In the opinion of the observer, clouds of any kind in any season of the year, taken alone, are of little value in weather forecasting. In spring, autumn, and winter rather low clouds with under surface broken, moving rapidly from easterly or southerly directions, and also a thin light sheet above a stratum of broken, dark fragments, indicate rain. In summer cumulus clouds of various forms preceded by arch of false cirrus precede rain.

During periods of abnormally high temperature the prevailing winds are from south to southeast. Cold winds come from the north to northwest.

Frost is likely to damage fruit or other crops from the middle of April to October 31. The general conditions that precede frost are, rising barometer, temperature 48° or below, with indications of falling to 36° or below, light north to northwest winds, and often light rain on the day preceding the occurrence of frost.

LANDER, WYO.

In spring and summer precipitation is usually preceded twelve to twenty-four hours by southwest winds, in autumn twenty-four to thirty-six hours by southwest winds, and in winter twenty-four to thirty-six hours by northeast winds. Preceding precipitation the barometer generally falls to 29.90 inches in spring, to 29.85 in summer and autumn, and to 30 or below in winter before precipitation begins. In all seasons the barometer begins to rise before precipitation begins.

The relative humidity usually increases twenty-four to thirty-six hours before precipitation. High humidity does not always indicate rain, however, and in summer and autumn rains occur with the relative humidity 50 per cent or below, and at times no rain occurs with the relative humidity near 90 per cent.

The extent to which upper clouds indicate precipitation is limited and uncertain. At times cirrus or cirro-stratus clouds moving from the west or northwest are observed twelve to twenty-four hours before precipitation. A rapid movement of stratus or strato-cumulus clouds from west or northeast generally presages rain or snow. The cloud movements at this station are generally slow.

During periods of abnormally high temperature the wind is from the southwest in spring, summer, and autumn, and the directions are about equally divided between northeast, southeast, southwest, and west in winter. The cold winds of spring are from the southeast, of summer and winter from southwest, and of autumn from northwest.

In spring frost is preceded by stationary barometer, low temperature, average humidity, northeast, southeast, west, or northwest winds, and is generally preceded by rain. In autumn and winter the same conditions obtain, except that the humidity is low preceding frost, and the wind is from southwest to northwest.

Frost is likely to damage vegetation from May 1 to June 20, and from August 20 to September 30.

LEWISTON, IDAHO.

Precipitation is usually preceded by southerly winds and falling barometer, but does not begin until the wind shifts to westerly and the barometer begins to rise. In spring and autumn the barometer gen-

erally falls to 29.90 or below, in summer to 29.80 or below, and in winter to 30 or below before precipitation begins.

During protracted periods of cloudy weather an increase in atmospheric moisture may be taken as an indication of rain. It has been observed that abnormally low humidity at 5 a. m. (the time of the morning observation) is frequently followed by rain before noon, local time.

Cirrus or cirro-stratus clouds moving from the west to northwest in spring, from southwest in summer and autumn, and from west to southwest in winter, are sometimes observed from forty-eight to seventy-two hours before precipitation, but frequently no precipitation occurs after the appearance of these clouds.

Frost is liable to damage fruit during the first half of May and early in November.

The period of observation at this station is too short to admit of accurate deductions; the above statements cover, however, the usual conditions that precede precipitation.

LEXINGTON, KY.

Precipitation is generally preceded eighteen to twenty-four hours by southeast to northeast winds and falling barometer. The severe storms of winter are preceded by east to northeast winds, and preceding summer precipitation the wind is usually from south to east. In spring and summer the barometer generally falls to 29.90 or below, and in autumn and winter to 30 or below before precipitation begins. In spring and summer, during the season of thunderstorms, the barometer is unsteady preceding rain, a condition that is not observed during the colder months.

There is generally a decrease in relative humidity in advance of precipitation. Except as an indication of more rain, during an intermission in a rainstorm, high humidity is not usually a precursor of rain, unless the rain is about to begin. As a rule the humidity can not be depended upon as an indicator of rain.

Cirrus, cirro-stratus, and alto-stratus clouds are almost invariably forerunners of rain in all seasons. These clouds appear about twenty-four hours in advance of precipitation and come from the southwest, except in winter, when they are more often seen coming from the west.

During periods of abnormally high temperature the wind is from the south in spring and winter and from the southwest in summer and autumn. The cold winds of all seasons are from the northwest.

Spring frosts are likely to damage fruit, vegetables, and other crops. In autumn crops are generally matured before the frost season. The general conditions that precede heavy frost are: rising barometer, falling temperature, low humidity, west to northwest winds diminishing in force, and clear or clearing weather.

LITTLE ROCK, ARK.

During the colder months precipitation is preceded twelve to twenty-four hours by south to southeast winds and falling barometer, and precipitation begins when the barometer is near the turn from falling to rising. In connection with storms that come from the southwest, precipitation is preceded by northeast winds and precipitation begins soon after the barometer begins to fall. During the warmer months thunderstorms are preceded six to twelve hours by southerly winds and falling barometer, and the wind shifts to westerly with rising barometer attending the beginning of rain. In all seasons the barometer generally falls to 29.90 or below before precipitation begins.

It has been observed that the moisture of the atmosphere increases twenty-four to forty-eight hours before precipitation in spring and winter and twelve to twenty-four hours before precipitation in summer and autumn, and that the more rapid the increase in moisture the greater the probability of precipitation.

Cirrus and cirro-stratus clouds moving from southwest in spring and summer and from southwest to west in autumn and winter are often observed twenty-four to thirty-six hours before precipitation.

During periods of abnormally high temperature the wind is from the southeast to southwest. During periods of unusually cool or cold weather the wind is from north to northwest, except in summer, when it comes from the east quadrant.

Frost is likely to damage fruit or other crops in March, April, May, September, and October. In spring and autumn frost is preceded by rising barometer, temperature falling to 40° or below at station, light or decreasing northwest winds, low or decreasing humidity, and clear or clearing weather.

LOS ANGELES, CAL.

In spring and winter, including October and November, easterly winds set in twelve and twenty-four hours before precipitation. Normal, followed by falling barometer, generally precedes rain winds. Rain is more likely to begin with the barometer about 29.90 or below in spring and about 29.80 or below in winter.

No increase or decrease in relative humidity is noted preceding rain. Excessive humidity occurs with fog which is rarely an accompaniment of rain, and more than the average humidity follows west to southwest winds from the ocean which are not rain-bearing winds.

Cirro-stratus clouds moving from the west generally forerun storms by periods that vary in length from one to three days, depending upon the movement of the storm-center; when these clouds are not followed by rain the weather usually becomes threatening. Detached

masses of clouds, more nearly resembling stratus, are generally observed about midway up the slopes of the Sierra Madre Mountains to the northeast of the station preceding general storms. These clouds are considered a good local sign of rain.

During periods of abnormally high temperature the prevailing winds are from the northeast to northwest in spring, from north to northwest in summer, from east to northwest in autumn, and from northeast to north in winter. The cold winds of all seasons are northerly winds.

Frost is most likely to damage fruit or other crops from December to March. The conditions that generally precede frost are: barometric pressure above the normal but relatively low as compared with pressures to the northward, temperatures at or below normal, low relative humidity, light winds, and a cloudless sky.

LOUISVILLE, KY.

In all seasons precipitation is preceded twelve to thirty-six hours by southeast to northeast winds and falling barometer, and the barometer generally falls to 29.90 or below in spring, summer, and winter, and to 30 or below in autumn before precipitation begins.

There is generally an increase in relative humidity preceding rain. This is most marked in spring and summer, but the period is not well defined. Rapidly increasing moisture after a period of low humidity is a strong indication of approaching rain, but is by no means a sure one.

Cirrus and cirro-stratus clouds indicate rain in this locality at all times of the year, but are far from being a sure sign of approaching rain. The interval between their first appearance and the beginning of precipitation is irregular; they frequently appear for several hours, then disappear, and reappear the next day. The prevailing direction of cirro-stratus clouds is from the west. No special cloud formation is known on which it would be safe to predict rain for this locality twenty-four hours or more in advance, but some cloud formations are of decided assistance when used in connection with a knowledge of the location of approaching storm areas.

During periods of abnormally high temperature the prevailing winds are from southeast to east in spring, from southwest to northwest in summer, and from south to southeast in autumn and winter. During periods of abnormally low temperature the prevailing winds are from west, northwest, or north.

Frost is likely to damage fruit or other crops from March 20 to April 30 and from September 15 to October 15. The general conditions that precede heavy frost are high barometric pressure following an area of low barometer, rapidly falling temperature, decreasing humidity, brisk west to north winds becoming light and nearly calm, and clouds disappearing and leaving a clear sky.

LYNCHBURG, VA.

Precipitation is usually preceded ten to twenty-four hours by easterly winds and falling barometer, and the barometer falls to 30 or below before precipitation begins, except in the case of storms that advance from the southwest, when precipitation begins shortly after the turn in the barometer from rising to falling.

Increasing atmospheric moisture indicates rain at all seasons, especially when accompanied by other favorable conditions, and its value in this respect is greatest during the summer months. The increase is usually noted twelve to eighteen hours before rain begins.

Cirrus and cirro-stratus clouds are usually forerunners of precipitation by twelve to eighteen hours in the warmer and twenty-four to forty-eight hours in the colder months. These clouds generally move from the west.

During periods of abnormally high temperature the prevailing winds are from the south in spring and autumn, from south to southwest in summer, and from southwest in winter. The cold winds of all seasons are from the northwest. High easterly winds come with falling and high westerly winds with rising barometer.

Frost is likely to damage apples from April 8 to 20, and peaches and plums from March 17 to 30. Fruit is most frequently damaged when a temperature of 15° or lower follows a warm spell in January or February. Tobacco is most likely to be damaged from September 15 to October 20. Heavy frost is generally preceded by barometric pressure rising above the normal, falling temperature, humidity about or a little below the normal, light north to northwest winds, and few if any clouds.

MACON, GA.

In spring and summer precipitation is usually preceded about twelve hours by southerly winds and falling barometer, and rain begins near the turn in the barometer from falling to rising. In autumn and winter northeast winds usually precede rain, and rain begins about the time the minimum barometer is reached. Rain begins most frequently, in all seasons, with the barometer between 29.90 and 30. During the colder months rain will sometimes begin with rising barometer and after the wind has shifted to northwest.

The relative humidity is always higher shortly before and after rains, and in some cases there seems to be an increase in relative humidity thirty-six hours before rain begins, but the available data are too limited to be conclusive. While dry air indicates no rain, moist air does not necessarily indicate rain.

Cirrus clouds moving from the southwest merging into cirro-stratus and alto-stratus on the southwest horizon are usually followed by rain in from twelve to thirty-six hours. Detached cirrus, cumulus,

and stratus clouds have little significance. In winter high alto-cumulus clouds from the west are some indication of snow if they come in the evening and show a tendency to thicken.

The cold winds of spring and winter are from the northwest, of summer from northwest, northeast, and southeast, and of autumn from northwest to northeast.

Heavy frost is likely to damage cotton during the first two weeks in November. Fruit will be damaged by a spring freeze after the buds have formed, and by a severe freeze in the latter part of February and the beginning of March. Frost is preceded by rising or high barometer, falling or stationary temperature, north to west winds diminishing to almost a calm, moderate humidity, and few if any clouds.

MEMPHIS, TENN.

In spring, autumn, and winter precipitation is preceded by south to southeast winds, and in summer by southwest winds. Preceding storms that advance from the southwest the winds come from the east or northeast. In all seasons, except in winter, precipitation that is preceded by south to southeast winds begins about the time the barometer is on the turn from falling to rising. When the wind is from the east and northeast rain begins with the barometer falling. In winter rain comes with falling, and snow with rising, barometer. Precipitation begins in spring with the barometer about 29.90, or below; in summer and autumn, with the barometer 30, or below; and in winter, with the barometer about 30.10, or below.

An increase in relative humidity is observed twenty-four hours or more before precipitation begins, except that a decrease in humidity is frequently noted at the morning observation on the day preceding rain.

In the spring cirrus clouds moving from the west or southwest and cirro-stratus from the southwest precede rain six to twelve hours. In summer cirrus or cirro-stratus clouds moving from the southwest are followed by rain in from twelve to twenty hours. In autumn and winter cirrus or cirro-stratus clouds from the west or southwest (especially from the southwest) are followed by rain within twenty-four hours, and this cloud movement is a sure sign of rain when the surface wind is from south or southeast.

During periods of abnormally high temperature the prevailing winds are from the southeast in spring, from the southwest in summer, and from south to southwest in autumn and winter. In all seasons the cold winds come from the northwest and incline more toward northerly in the autumn. During winter, early spring, and late autumn periods of unusual cold are usually followed by rain within thirty-six to forty-eight hours. The high winds of all seasons come from west

to northwest with rising barometer, except in the case of summer thunderstorms, when they are from southwest to west.

Frost is most likely to damage fruit or other crops in March, April, May, September, and October. The greatest damage to fruit can occur during the latter part of March and the early part of April. Frosts late in October injure the "top crop" in cotton. The general conditions that favor heavy frost are rising barometer for twenty-four hours, wind shifting to fresh northwest, and decreasing, low relative humidity, and clearing or clear sky.

MARQUETTE, MICH.

Storms from the southwest are preceded by east to northeast winds and falling barometer, and in winter precipitation begins shortly after these conditions are developed. Storms from the west and northwest are preceded by southeast shifting to southwest winds and falling barometer, and precipitation begins about the time the barometer is near the turn from falling to rising. During the colder months precipitation comes in the form of snow, with northeast winds and falling barometer, and snow continues after the wind shifts to north and northwest with rising barometer. The upper peninsula of Michigan is probably the most difficult section in the United States for which to forecast precipitation. The usual premonitary signs of weather changes, more particularly as regards rain and snow, fail utterly at times, and precipitation appears to depend upon the relative amount of moisture in the air, and the difference in temperature at points along the south shore of Lake Superior and the temperature of the air that is brought thither from the land in summer and from the lake in winter. In short, the cold necessary for condensation of moisture is a subject for close calculations of wind directions, which in this section are extremely difficult to make.

An increase in relative humidity is generally observed several hours before precipitation, but, at times, when the wind shifts suddenly to points from over the lake the increase is rapid and the chance of subsequent precipitation is again dependent upon temperature con ditions.

In spring, summer, and autumn cirrus clouds moving from the west are often observed eight to thirty hours before precipitation. In winter the upper clouds are seldom seen, owing to the prevalence of stratus or nimbus clouds. Alto-stratus and stratus clouds moving from the west or northwest in spring and autumn, from the southwest, west, or northwest in summer, and from the west, northwest, north, and northeast in winter are observed preceding precipitation.

The high winds of spring, summer, and autumn come from the southeast to southwest with falling barometer, and in winter they usually come from the northwest with rising barometer. The warm

winds of spring and autumn are from the south, of summer from south to southwest, and in winter abnormally high temperature prevails with calm air or light south to southwest winds. The cold winds of spring come from the southwest and west, of summer from north and northeast, of autumn from the west, and of winter from the southwest, west, and northwest.

Frost is likely to damage crops from June 1 until the early part of September. The conditions under which frost occurs are high barometric pressure, temperature below 40°, low humidity, calm air, and no clouds.

MERIDIAN, MISS.

Easterly winds and falling barometer precede rain six to twenty-four hours in spring. In summer southeast winds and falling barometer precede general rains five to ten hours, and local rains come on the turn of the barometer from falling to rising. In autumn rain is preceded twelve to twenty-four hours by northeast winds and falling barometer. In winter the barometer usually falls five to fifteen hours, with northeast to southeast winds, before precipitation begins, and sometimes light precipitation occurs after the barometer begins to rise. In spring and summer the barometer generally falls to 30 or below, and in autumn and winter to 30.05 or below, before precipitation begins.

Precipitation is usually preceded by an increase in relative humidity in spring and summer, and a decrease followed by an increase in relative humidity in autumn and winter. In summer an increase in the amount of moisture in the air is a good indication of rain; in spring and autumn it is an indication of rain only during cloudy conditions; in winter it is an occasional but not a good indication of rain.

The upper clouds, especially the cirro-cumulus, are forerunners of rain in all seasons. In spring and autumn cirrus or cirro-stratus clouds moving from the southwest appear about twenty hours before rain, and in summer and winter these clouds appear, moving from the west, six to twenty-four hours before precipitation begins. Rain seldom fails to follow well-defined cirro-cumulus clouds at any season of the year.

The warm winds of spring are southerly, of summer westerly and northwesterly and occasionally southwesterly, of autumn southwesterly, and of winter southerly and southwesterly. The cold winds of all seasons are northwesterly, inclining in winter toward northerly.

Frost is likely to damage fruit or other crops from February 15 to May 15 and from September 15 to November 10. Heavy frost occurs more readily in the spring than in the autumn, owing possibly to the temperature of the soil and plants; conditions that will produce a heavy frost in spring will not result in as heavy a frost in autumn.

Frost generally occurs on the second or third night of a cold spell, with light wind, clear weather, humidity low on the preceding day, and moderately high and nearly stationary barometer.

MILWAUKEE, WIS.

Precipitation is usually preceded twelve to twenty-four hours by winds that set in from the east quadrants with falling barometer, and the barometer generally falls to 30 or below before precipitation begins. When storms advance from the west or northwest, the wind sets in from the southeast quadrant, and during the warmer months rain generally begins about the turn of the barometer from falling to rising. When storms advance from the south or southwest, the wind sets in from the northeast quadrant and precipitation usually begins while the barometer is falling. During the colder months snow often begins closely following the shift of wind to the northeast quadrant and with high but falling barometer. The strength of a storm depends on the rate and amount of the fall in the barometer.

The relative humidity usually increases before precipitation, but owing to the fact that the "rain winds" blow from over the lake, it is not possible to distinguish between local and general humidity conditions as indicators of precipitation. The humidity must, in each instance, be considered in connection with other indications.

Cirrus and cirro-stratus clouds move from the southwest in spring and winter and from the west in summer and autumn. The appearance of these clouds is often followed within twelve to twenty-four hours by precipitation.

The highest wind velocities of summer usually come with wind shifting from southerly to westerly and on the turn in the barometer from falling to rising. Occasionally, however, high velocities occur in summer with easterly winds and falling barometer. The highest velocities of the colder months generally come with southeast to northeast winds and falling barometer, which attend the approach of storms from the lower Missouri Valley or the Southwest. High velocities also occur during the colder months from the west and northwest with rising barometer.

During periods of abnormally high temperature the wind comes from south to southwest in spring and autumn, from points between south and west in summer, and from northeast to southeast in winter. The cold winds of early spring are from west to north points, of late spring and summer from points between southeast and northeast, and of late autumn and winter from west, northwest, and north.

Fruit is likely to be damaged by frost during the blooming period, which extends from April 15 to June 1. The cranberry crop is subject to damage by frost in the autumn.

The general conditions that usually precede the occurrence of heavy frost are: Barometer rising above the normal, temperature falling to 40° or below, light westerly winds, and a clear sky.

MINNEAPOLIS, MINN.

In spring, autumn, and winter precipitation is preceded by southeast to northeast winds and falling barometer, and precipitation usually begins when the barometer has fallen to 29.90 or below. In summer rain generally begins with the shift of wind to westerly and near the turn of the barometer from falling to rising. During the colder months light precipitation frequently continues after the barometer begins to rise and the wind has shifted to points between west and northwest.

No note has been made at this station of either the humidity of the air or clouds, nor of their observed relation to precipitation. (See St. Paul report.)

Very little injury is caused by frost before May 15. Frost as late as June 5 affects barley, oats, corn, vegetables, and fruit to some extent. Frost usually occurs under the crest of a high-pressure area, with low temperature, low humidity, clear weather, and nearly calm air, following a northwest wind.

MOBILE, ALA.

In spring and winter rain is preceded twenty-four to forty-eight hours by southerly winds and falling barometer, and the barometer falls to 30 or below before rain begins. In summer and autumn rain is preceded twenty-four to thirty-six hours by south to southeast winds, and rain usually begins after the turn in the barometer from falling to rising.

In spring and winter high winds generally come from the northwest with rising barometer; in summer the high winds are usually easterly and occur in connection with thunderstorms; the high winds of autumn are more often from the southeast with falling barometer.

An increase in relative humidity is noted two to three days before rain, except in the case of summer thunderstorms, when the increase is shown about eight hours before rain begins.

Cirrus or cirro-stratus clouds, moving from the west in spring and winter, from the southwest in autumn, and with no apparent direction of movement in summer, often precede precipitation twenty-four to forty-eight hours.

The warm winds of spring and winter are from southerly directions, and in summer and early autumn periods of unusually high temperature are attended by northerly winds. The cold winds of winter come from north to northwest.

Frost is likely to damage fruit or other crops from September to April, inclusive. As the climate of this district permits the production of crops of some description, in all seasons, the occurrence of frost will, at any time, cause damage. The conditions favorable for frost are high barometric pressure, temperature as observed at station 40° or below, light wind, and clear weather.

MONTGOMERY, ALA.

In spring and summer precipitation is usually preceded by southeast winds about thirty hours, and in autumn and winter by easterly winds from eighteen to twenty-four hours. In all seasons the barometer generally falls to 30 or below before precipitation begins, although in summer and autumn precipitation may begin with rises in the barometer which come from high barometer areas backing in or spreading from the east. This is most noticeable in winter. A barometric depression over southern Texas or Louisiana is an almost positive indication of rain in this section within twelve to eighteen hours. If the low area moves eastward along the Gulf coast the rains are light to moderate, but continue longer; if the low area moves northeastward the rainfall is heavy, but is quickly followed by clearing weather.

The relative humidity usually increases about twenty-four hours preceding rain, particularly in spring and winter, and the more marked the increase the greater is the likelihood of rain.

Cirrus clouds usually appear in patches in the western sky ten to twenty-four hours before rain, and settle to cirro-stratus as rain approaches. In autumn, winter, and spring a bank of cirro-stratus clouds in the southwestern sky is almost sure to be followed by rain within twelve hours. In summer low cumulus clouds moving from the south in the morning are quite often followed by showers in the afternoon.

During periods of abnormally high temperature the winds are from the south in spring, from northwest to north in summer, and from southeast to southwest in autumn and winter. During periods of unusually cold weather the winds are from the northeast to north in spring, from northeast to east in summer, from northwest to northeast in autumn, and from west to north in winter.

During March, April, and May fruit and early vegetables are subject to damage by frost. Cotton is likely to be damaged by frost during the latter part of April and in May and also in September and October. Sugar cane is in a condition to be damaged by frost in September and October. The general conditions that precede heavy frost are increasing barometric pressure, rather low humidity, light winds, mostly from west to north, and an absence of lower clouds.

MOORHEAD, MINN.

In all seasons precipitation is preceded about twelve hours by falling barometer and southeast winds, and the barometer falls to 30 or below in spring and winter, and to 29.90 or below in summer and autumn, before precipitation begins.

There is usually an increase in relative humidity several hours before precipitation begins.

Cirrus or cirro-stratus clouds are usually observed moving from the west six to twelve hours before precipitation begins.

The warm winds of all seasons are from the southeast and the cold winds from the northwest.

From August 15 to September 30 frost will damage wheat, flax, and other grain that is not ripe.

Damaging frost is likely to occur when pressure above 30, temperature about freezing, relative humidity 70 to 90 per cent, southeast winds, and partly cloudy or clear weather are indicated.

NANTUCKET, MASS.

Precipitation is generally preceded by falling barometer and southerly winds, and begins twelve to twenty-four hours after the barometer begins to fall, and after it reaches 29.90 or below in spring, summer, and autumn, and 30 or below in winter. In the case of storms that advance from the southern quadrants, however, precipitation begins soon after the wind shifts to east or northeast, and closely following the turn in the barometer from rising to falling.

There is usually an increase in relative humidity twelve to twenty-four hours before precipitation. The prevalence of fog in spring, summer, and autumn also has the effect of causing high humidity.

In the spring cirrus or cirro-stratus clouds moving from the north and northwest often precede precipitation twelve to twenty-four hours; in summer and autumn alto-stratus clouds moving from southwest, west, or northwest precede precipitation twelve to twenty-four hours; in winter upper clouds moving from the northwest quickly change to stratus preceding precipitation.

High winds generally come from the southerly with falling barometer, from the northwest with rising barometer, and from the northeast with either rising or falling barometer.

The warm winds of all seasons are from the southwest, and the cold winds from northeast in spring, summer and autumn, and from northwest in winter.

Damage may be caused by frost from May 1 to July 1, and during September. Frost will occur with high barometer, temperature about 40°, relative humidity 54 to 83 per cent, fresh northeast winds during the early evening that flatten out during the night with a cloudless sky.

NASHVILLE, TENN.

Precipitation is usually preceded twelve to twenty-four hours by southerly winds and falling barometer; in cases where storms advance from the Gulf of Mexico or the Rio Grande valley precipitation is preceded by easterly winds. During the colder months the barometer falls to 30 or below before precipitation begins; in summer showers come about the time of the turn in the barometer from falling to rising.

There is generally an increase in relative humidity twelve to twenty-four hours before precipitation, except in connection with summer showers when the increase in air moisture is at times not appreciable until after rain begins.

Beyond the fact that cirrus and cirro-stratus clouds move from the west no notes have been made at this station regarding the relation between clouds and precipitation.

Periods of abnormally high temperature are associated with south to southeast winds, and periods of abnormally low temperature with north to northwest winds, except in summer, when the cooler winds are from east to northeast.

Frost is likely to damage fruit or other crops from April 1 to May 1, and from about the middle to the last of December. Heavy frost is usually preceded by high barometric pressure, unseasonably low temperature, moderate humidity, light winds, and clear weather.

NEAH BAY, WASH.

In all seasons precipitation is preceded for a short period by southerly winds. During the colder months steady rain sets in with falling barometer, and showers occur with rising barometer. In summer and until late in the autumn precipitation occurs just after the turn in the barometer from falling to rising. Rain begins with the barometer at various heights, but more often after it has fallen to 29.90 inches or below.

Owing to the moisture of the climate in this section no definite increase or decrease of atmospheric moisture can be determined for any considerable period preceding precipitation.

Cirro-cumulus clouds are good indicators of rain, and they appear moving from the west a few hours before precipitation in winter and about twelve hours before in summer.

High winds occur from the southwest to west with rising barometer.

The warm winds of spring and winter are from the south, of spring from the east, and of autumn from the east and south. The cold winds of spring are from west and northwest, of summer from west and southwest, of autumn and winter from northwest and northeast.

No fruit or other crops are raised in the vicinity of Neah Bay.

NEW HAVEN, CONN.

Precipitation is usually preceded about twelve hours by east to southeast winds and falling barometer, except in summer, when showers occur with the shift of wind from southerly to southwest, and on the turn of the barometer from falling to rising. In the case of storms that advance from the south or southwest east to northeast winds precede precipitation and rain or snow begins shortly after the wind shifts to easterly quarters and the barometer begins to fall. Except in the case of storms that come from the south or southwest precipitation generally begins when the barometer has fallen to 29.90 or below in spring, summer, and autumn, and to 30 or below in winter.

On account of the humid condition of the atmosphere at this station, and the prevalence of light fogs, no relation has been detected between the relative humidity and the approach of rain. The winds which precede precipitation, coming from southerly and easterly, are, however, the moist winds, and although an increase of humidity precedes rain, it may not in itself indicate approaching rain.

In spring, summer, and autumn cirro-stratus clouds coming from the west or southwest often precede rain about thirty-six hours. In winter the relation is not so definite and the interval between the appearance of clouds of this type is shorter. During the colder months cirro-stratus clouds more often come from the southwest, and during the warmer months from the west.

The high winds of spring, summer, and autumn are from southeast and northeast with falling barometer, and of winter from southeast or northeast with falling and from northwest with rising barometer.

During periods of abnormally high temperature the wind is from the south in spring, and from southwest in summer, autumn, and winter. The cold winds of spring, autumn, and winter come from northwest to north, and of summer from the southeast.

Frost is likely to damage fruit or other crops from April 15 to June 1, and from September 1 to October 15. Heavy frost is generally preceded by rising barometer, falling temperature, high relative humidity, light northwesterly winds, and few if any clouds.

NEW ORLEANS, LA.

In spring, autumn, and winter southeast or northeast winds set in about twelve hours before precipitation, and in summer southeast winds precede rain about four hours. As a rule the barometer falls when winds from these directions prevail, but, at times, it rises when northeast winds that precede rain occur in the winter. In all seasons the barometer generally falls to 30 or below before precipitation begins.

In all seasons of the year a steady increase in relative humidity for twenty-four hours is, as a rule, followed by rain.

In spring there are no clouds that specially indicate rain. In summer cirrus or cirro-stratus clouds moving from the southwest are nearly always followed by rain in about thirty-six hours. In autumn cirrus or cirro-stratus clouds moving from points between southwest and north are nearly always followed by rain within thirty-six hours. In winter cirrus or cirro-stratus clouds moving from the west precede precipitation for the period named.

High winds occur with falling barometer and south to east winds, and with rising barometer and northeast to northwest winds.

During periods of abnormally high temperature the wind is from south and southeast in spring, from southeast, south, and southwest in summer, from south, southeast, or east in autumn and winter. During periods of abnormally low temperature the wind is from northwest, north, or northeast.

Frost is likely to damage fruit or other crops from October 15 to April 15. Sugar cane is most likely to suffer damage from frost and cold from November 1 to January 15. The general conditions which precede frost are rising barometer, temperature 36° to 40°, humidity low, wind light from northwest to northeast, and few clouds or clear weather

NEW YORK, N. Y.

In spring, autumn, and winter precipitation is preceded twelve to twenty-four hours by south to southeast winds, and in summer twenty-four to forty-eight hours by southerly winds. In spring and autumn the barometer usually falls to 29.90 or below and in winter to 30 or below before precipitation begins. In summer showers generally begin about the turn of the barometer from falling to rising. In the case of storms that come from the south or southwest, however, precipitation is preceded by east to northeast winds, and rain or snow begins closely following the shift of wind to these quarters and the turn in the barometer from rising to falling.

As a rule there is an increase in relative humidity twelve to twenty-four hours before precipitation, and in spring, autumn, and winter rain or snow may be expected when the atmosphere is becoming highly charged with moisture.

Generally speaking, the formation of cirrus and cirro-stratus clouds indicates the coming of rain or snow. No definite interval has been observed between the appearance of these clouds and the beginning of precipitation, but it probably varies from eighteen to thirty-six hours. In the spring and winter cirrus and cirro-stratus clouds come from the west, in summer from the southwest, and in autumn from the west and southwest. Precipitation is indicated in spring by the formation of low clouds, without a very pronounced movement, but usually from

easterly quadrants, in summer by the rapid formation of thunder clouds, with shifting and increasing winds, in autumn by low cloud formations moving from easterly quadrants, and in winter by high cloud formation, followed by heavy low clouds and easterly winds.

In all seasons the highest winds generally come from the northwest, with rising barometer.

During periods of abnormally high temperature the wind is from the south in spring and winter, and from the southwest in summer and autumn. During periods of abnormally low temperature the wind is from the northwest in spring, autumn, and winter, and from northwest, north, or northeast in summer.

Frost is likely to damage fruit or other crops in this section from April 1 to May 20. Heavy frost is preceded by high and nearly stationary barometer, temperature below 44°, relative humidity about normal, gentle, or light winds, and an absence of clouds, or, when existing, cirrus clouds.

NORFOLK, VA.

Precipitation is preceded by southerly and easterly winds. Southerly winds precede precipitation, with falling barometer, twelve to twenty-four hours. Precipitation closely follows the shift of wind to east and northeast during the colder months, and precipitation begins during those months, and with east to northeast winds, about the time of the turn of the barometer from rising to falling. During the summer months rain does not necessarily attend a shift of wind to easterly quadrants except in cases where storms are advancing from the south or southwest. In all seasons the barometer usually falls to 30 or below before precipitation begins, except in the case of storms from the south or southwest, when, as before stated, precipitation closely follows the shift of wind to east or northeast, irrespective of the height of the barometer.

During the colder months an increase in relative humidity is a good indication of precipitation, and the increase precedes the beginning of precipitation but a few hours.

Upper clouds moving from the west often precede precipitation twelve to thirty-six hours. In spring cirrus clouds are more often observed; in summer cumulus appear five to ten hours before rain, while in autumn and winter cirro-stratus clouds precede rain twenty-four to thirty-six hours.

The high winds of this station come from southerly and easterly with falling, and from southwest, west, and northwest, with rising barometer.

The warm winds of spring and autumn are from south and southwest; of summer from southwest, west, and northwest, and of winter from the south. The cold winds of spring are from northwest, north, northeast, and east; of summer from north, northeast, and east; of

autumn from northwest and north, and of winter from west, northwest, and north.

Frost is likely to damage fruit or other crops after April 1 and before October 15. Heavy frost is preceded by normal or high barometric pressure, temperature below 40°, relative humidity 70 to 85 per cent, wind light from northwest or north, and clearing or clear weather.

NORTH PLATTE, NEBR.

In spring and winter precipitation is preceded about twelve hours by northeast winds and falling barometer and begins about the time the barometer is on the turn from falling to rising. In autumn easterly winds precede precipitation about twelve hours, and in summer rain usually begins with northwest winds and on the turn of the barometer from falling to rising. A rapid fall in the barometer is more often followed by rain or snow than a slow fall. In spring and summer the barometer generally falls to 29.90 or below and in autumn and winter to 30 or below before precipitation begins.

While an increase in relative humidity frequently indicates precipitation, especially during the colder months, it can not be relied upon to any great extent. This increase is shown in spring, autumn, and winter seven to twelve hours before, and in summer about one hour before, precipitation.

In spring, autumn, and winter cirro-stratus clouds moving from the west sometimes appear twenty-four hours in advance of precipitation, and in summer strato-cumulus at times appear about twelve hours before rain begins. The cloud indications of precipitation are, however, slight for any considerable period before the beginning of rain or snow.

High winds come from south to southeast with falling and from northwest with rising barometer.

During periods of abnormally high temperature the wind is from the south in summer and autumn and from the southwest in spring and winter. During periods of abnormally low temperature the wind is from the north in spring and summer, from the west in autumn, and from the northwest in winter.

Frost is likely to damage vegetation during the spring and autumn months. Heavy frost is usually preceded by high barometeric pressure, temperature near the freezing point, high relative humidity, light westerly winds, and either clear weather or a few cumulus clouds.

OKLAHOMA, OKLA.

Precipitation is preceded twelve to forty-eight hours by south to southeast winds and falling barometer, and begins about the time the barometer falls to 29.90 or below and is near the turn from falling to

rising. In winter precipitation often begins when the barometer has fallen to about 30 and after it has begun to rise and the wind has shifted from southerly to northerly.

No definite relation has been observed between atmospheric moisture and precipitation. At times the relative humidity decreases for several days in advance of rain and then increases immediately before precipitation begins.

Cirrus and cirro-stratus clouds are rarely observed, but at times these clouds are noted moving from the northwest one to two days in advance of precipitation.

High southerly winds occur with falling, and high northerly winds with rising barometer.

During periods of abnormally high temperature the winds are from the south. The cold winds of spring, autumn, and winter are from the north, and of summer from the southeast.

Frost is likely to damage crops in March, April, May, September, and the first half of October.

Frost generally occurs with rising or high and stationary barometer, temperature falling to 40° or below, average relative humidity, clear weather, or but few clouds, and light northerly winds.

OMAHA, NEBR.

Precipitation is usually preceded twelve to thirty-six hours by southeast winds and falling barometer, and the barometer falls to 29.90 or below in the warmer months and to 30 or below in the colder months before precipitation begins. In summer and during the month of September rain generally begins after the turn in the barometer from falling to rising.

While some definite relation between precipitation and relative humidity may exist, this relation is not shown by the tabulation of 8 a. m. and 8 p. m. observations. It appears, however, that there is an increase in humidity before precipitation during the colder months and a decrease during the warmer months.

Cirrus or cirro-stratus clouds, moving from the west in spring and winter and from the southwest in summer and autumn, often appear thirty to forty hours before precipitation.

The warm winds of spring, summer, and autumn are from southeast to southwest, and of winter from south to southwest. The cold winds of all seasons are from northwest to north.

Frost is likely to damage fruit or other crops from April 1 to May 15, and from August 20 to October 1.

Damaging frost occurs about the time of the maximum of waves of high barometric pressure, with temperature a little below 40°, decreasing relative humidity, few if any clouds, and light winds from westerly or northerly.

OSWEGO, N. Y.

South to southeast winds generally precede precipitation about twenty-four hours, and the barometer falls to 29.90 or below in spring and summer, and to 30 or below in autumn and winter before precipitation begins. In the case of storms that advance from the southwest, however, the wind shifts to northeast and precipitation begins, closely following this shift of wind and shortly after the barometer begins to fall.

During all seasons of the year there is a decrease of relative humidity twelve to twenty-four hours before precipitation, followed by an increase just preceding the beginning of precipitation. Unusual dryness of the atmosphere has been considered a good indication of rain within the next twenty-four hours.

Cirrus and cirro-stratus clouds, moving from the west, are generally followed by precipitation within twenty-four to forty-eight hours, more especially during the colder months.

High winds occur from the south and southeast with falling, and from the west and northwest with rising barometer.

South winds attend periods of abnormally high temperature. The cold winds of spring and winter come from the northwest, and of summer and early autumn from the southeast.

The critical period of damage by frost in the spring for strawberries and other fruits is from May 15 to about June 10. In the autumn frost will cause damage to tomatoes, grapes, corn, and late potatoes from September 15 to about October 1. In a belt about 4 miles wide, extending along the lake, no damage has been caused by frost in several years; and cold northwest to northeast winds occurring in blossom time are much more feared than frost.

In spring and autumn frost is likely to occur with rising barometer, temperature falling to or below 40°, increasing relative humidity, light southwest to west winds, and few if any clouds.

PALESTINE, TEX.

In spring and summer rain is preceded twelve to forty-eight hours by southerly winds and falling barometer, and in autumn and winter precipitation is preceded to twelve twenty-four hours by southeast to northeast winds and falling barometer. In spring, summer, and early autumn rain usually begins when the barometer has fallen to 29.90, or below, and is on the turn from falling to rising. In late autumn and winter precipitation generally begins when the barometer has fallen to 30 or below and after the turn in the barometer from falling to rising.

A sudden rise of a tenth of an inch in the barometer is more likely to precede a shower than is a sudden fall in the barometer. The barometer is often stationary after falling, just preceding, and during

heavy rain. A falling barometer at night, and a rising barometer from a low, precedes rain. Clearing weather occurs when the barometer is well on the turn from a low reading, especially if the wind shifts to northwest.

There is generally an increase in the relative humidity of the air during all seasons twelve to twenty-four hours in advance of precipitation. The increase is, however, most marked immediately before rain begins. It often happens that low humidity is followed by rain within twelve to twenty-four hours. The moisture of the air, in the absence of decreasing temperature, does not operate to any great extent as a sign of approaching rain.

Cirrus and cirro-stratus clouds move from the west. The records show that it is rather the exception for cirrus or cirro-stratus clouds to have any prognostic value as to the time rain is likely to follow. It has been noted, however, that when rain follows the first appearance of cirrus or cirro-stratus clouds it occurs within twenty-four to thirty-six hours. This applies to all seasons of the year. Alto-stratus clouds moving from the west are an infallible sign of rain; stratus on the eastern horizon in the early morning presage rain; lower clouds moving from south or southeast, with northerly winds, bring rain. In summer dense cumulus in the northwest usually presage rain.

High south to southeast winds occur with falling and high west to northwest winds with rising barometer.

During periods of abnormally high temperature the winds are from the south. In spring and winter cold winds come from the northwest and in summer and autumn from the northeast.

Serious damage would result from heavy frost occurring between March 15 and December 1. April and October frosts are much dreaded.

In all seasons the barometer and temperature are above the normal twenty-four to thirty-six hours preceding frost, and frost usually occurs on the second day of falling temperature, with high humidity forty-eight hours preceding and a slight decrease in humidity twenty-four hours preceding its occurrence. Fresh north to northwest winds in spring, fresh north in autumn, and fresh northeast in spring and winter usually precede frost, with as a rule clear skies.

PARKERSBURG, W. VA.

South to east winds and falling barometer usually precede precipitation twelve to twenty-four hours, and the barometer generally falls to 29.90, or below in spring and winter, and to 30 or below in summer and autumn before precipitation begins.

A decrease, followed by an increase, in relative humidity usually precedes precipitation.

Cirrus and cirro-stratus clouds from the west presage rain or snow within twelve to twenty-four hours.

The warm winds of all seasons are from the south, and the cold winds from west, northwest, and north.

Frost is likely to damage fruit or other crops from April 15 to May 30, and from September 30 to October 5.

The conditions that are favorable to the occurrence of frost are an area of high pressure overspreading the Ohio Valley, decreasing temperature and humidity, westerly winds, and clear weather or alto-cumulus clouds.

PENSACOLA, FLA.

Precipitation is preceded by southeast to northeast winds and falling barometer, and the barometer generally falls to 30 or below before precipitation begins. For rainstorms the barometer falls slowly for two or three days and then more rapidly, and rain begins several hours before the lowest point is reached and ends after the barometer has begun to rise. In summer there are showers with slowly falling barometer until shortly before the lowest barometer is reached, when there is a heavier fall of rain. In fall and winter rain often begins shortly after the barometer begins to fall.

Except in summer there is an increase in relative humidity noted at the morning observation of days on which rain falls. The humidity at that hour does not in itself indicate rain, but when coupled with temperature above the normal and rain winds it does. A warm, moist atmosphere is often present before fog.

Cirrus and cirro-stratus clouds have been generally observed moving from the northwest, and at times have preceded rainstorms about twenty-four hours. Cirro-stratus merging into alto-stratus, strato-cumulus, and stratus presage rain. Cirrus and cirro-stratus have been observed without rain, but when these clouds merge into clouds of lower formation rain usually follows.

The highest winds of this station generally come from the southwest with falling barometer and near the turn from falling to rising barometer.

During periods of abnormally high temperature the winds are from southeast to southwest in spring and winter, from northwest to northeast in summer, and from north to east in autumn. The cold winds of spring and winter are from the northwest to northeast, of summer from northeast to southeast, and of autumn from north to northeast.

No fruit is raised in this vicinity, and the few vegetables that are grown are subject to damage by frost during all seasons of the year.

The general conditions that precede heavy frost are rising or high barometer, falling or low and stationary temperature, low relative humidity, few if any clouds, and light northwest wind.

PHILADELPHIA, PA.

Precipitation is generally preceded twelve to twenty-four hours by south to east winds and falling barometer, and the barometer usually falls to 30 or below before precipitation begins. In the case of storms that advance from the south and southwest, however, precipitation begins closely following the shift of the wind to east or northeast, and often when the barometer is on the turn from rising to falling; this is more particularly true with regard to south and southwest storms of the colder months.

In spring, autumn, and winter there is an increase in relative humidity to 80 per cent or over six to twelve hours before precipitation begins, and in summer there is an increase to 70 per cent or over one to six hours before rain.

Cirrus and cirro-stratus clouds moving from the west are frequently observed twelve to twenty-four hours before precipitation. First comes the cirrus then cirro-stratus, followed by haze or stratus, and sometimes cirro-cumulus.

High northwest winds occur with rising barometer in spring, autumn, and winter, and high northeast winds with falling barometer. In summer high winds usually come from the south and southwest about the time of the turn in the barometer from falling to rising.

The warmer winds of all seasons come from the southwest. During the warmer months the cool winds come from the northeast, and during the colder months the cold winds come from the northwest.

Frost is likely to damage fruit and other crops from April 10 to May 10, and before October 15.

The conditions that favor the occurrence of heavy frost are high and increasing barometric pressure, temperature 40° and falling, relative humidity normal or below, cumulus clouds followed by clearing, and light northerly or westerly winds.

PHOENIX, ARIZ.

In spring and winter southeast to southwest winds and falling barometer precede precipitation for periods that average about twenty-four hours, and the barometer falls to about 29.90 or below before precipitation begins. From late in the spring until the beginning of winter the prevailing winds are from the easterly, and preceding rain the wind shifts to northerly or northwesterly, with falling barometer.

While there is usually an increase in relative humidity preceding rain, rain sometimes occurs when the surface air shows a decreasing amount of moisture.

Cirrus and cirro-stratus clouds move from the west and are forerunners of rain only to a limited extent.

High winds occur with a falling barometer from the southwest in spring, from east and southeast in summer, from southeast in autumn, and from the west in winter.

The cold winds of spring, autumn, and winter come from the west and northwest.

Frost is likely to do damage in December, when citrus fruits are still on the trees, and in February and March, when citrus trees and almond trees are budding and blooming.

The conditions favorable for frost are low followed by rising barometer, temperature falling to or below 40°, few if any clouds, and southwest or west veering to light northwest or north winds.

PIERRE, S. DAK.

In all seasons precipitation is preceded twelve to twenty-four hours by east to south winds and falling barometer, and precipitation begins after the turn in the barometer from falling to rising. In spring, summer, and autumn the barometer falls to 29.90 or below and in winter to 30 or below before precipitation begins.

At times, and more especially during the colder months, there is an increase in relative humidity twelve to twenty-four hours before precipitation; as a rule, however, the increase is not marked at the hours of regular observation.

Cirrus and cirro-stratus clouds move from the west and northwest in spring and winter, from west and southwest in summer, and from west in the autumn, and the period of their appearance before precipitation varies from six to seventy-two hours. In spring if these clouds merge into alto-stratus rain falls within twelve hours. In summer if they increase in density during the heat of the day they are at times followed by thunderstorms. In autumn the conditions are not well marked. In winter increasing alto-stratus clouds are followed by snow, often in four to six hours, but more frequently in six to twelve hours. Cirro-stratus to alto-stratus moving with moderate speed from a westerly direction, strato-cumulus from the same direction as the surface wind that is blowing brisk from southeast or east and continuing twenty-four to seventy-two hours presage rain. This type is most prominent in spring, summer, and fall. Alto-cumulus that follow alto-stratus are often followed by rain in six to twelve hours, and constitutes the best type for the year round. Alto-stratus in winter moving from the southwest at moderate speed usually presage rain or snow.

During periods of abnormally high temperature the wind blows from southeast and south in spring and summer, and from southeast to southwest in autumn and winter. The cold winds of all seasons are northerly winds.

Frost is likely to cause damage from the middle of April to the first week in June, and from the last of August to the first week in October. In spring heavy frost will occur with high barometric pressure, temperature 42° to 54° and falling, low humidity, northerly winds becoming light and variable, and alto-stratus or strato-cumulus clouds clearing away about sunset. In the late fall and winter months the humidity is generally higher before frost, and frost often fails to occur when other conditions are favorable for its occurrence, owing to low humidity, especially in late fall, winter, and early spring.

PITTSBURG, PA.

Precipitation is usually preceded by southeast to northeast winds and falling barometer for periods of ten to twenty-four hours, and the barometer generally falls to 29.95 or below in spring and autumn and to 29.90 or below in summer and winter before precipitation begins. In the case of storms that advance from the south and southwest, however, precipitation often begins closely following the shift of wind to the northeast and the turn in the barometer from rising to falling.

A low percentage of relative humidity generally indicates fair weather for the next twenty-four hours. In spring and summer rapidly increasing relative humidity indicates approaching thunderstorms. In autumn and winter the relative humidity is abnormally low twenty-four hours before precipitation and then begins to increase. Whem abnormally low at 8 a. m. a shower generally occurs before night.

Nothing satisfactory can be given regarding cloud observations on account of the smoky conditions that prevail.

The high winds of all seasons usually come from the southwest with falling and from the west with rising barometer.

During periods of abnormally high temperature the wind comes from the south in spring and winter, from the south and southwest in summer, and from the southeast in autumn. The cold winds of all seasons come from northwest to north.

Frost is likely to damage fruit or other crops in May and September.

The conditions that favor the occurrence of frost are rising and high barometer, temperature falling to 40° or below, a decrease of about 10 per cent in relative humidity eight to twelve hours preceding frost, light winds and clear weather.

POCATELLO, IDAHO.

In spring and autumn precipitation is preceded about twelve hours by south to west wind and falling barometer, in summer about six hours by south winds, and in winter snow is preceded twelve to

twenty-four hours by southwest winds. In all seasons the barometer falls to about 29.80 or below and begins to rise before precipitation begins.

In spring and autumn there is a slight increase in relative humidity six to twelve hours before precipitation, and in winter an increase occurs twelve to twenty-four hours before precipitation. In summer there is an apparent decrease in relative humidity about twelve hours before rain.

Precipitation is generally preceded twelve to twenty-four hours by the appearance of upper clouds. Alto-stratus appears, however, to have been the kind of clouds most frequently noted at this station in connection with precipitation.

The high winds of this station come with rising barometer and when they shift from southerly to westerly.

The warm winds of spring and winter come from the south, of summer from south to southeast, and of autumn from the southeast. The cold winds of spring and winter come from the northwest, of summer from the west, and of autumn from the north.

Frost is most likely to cause damage to vegetation during the first ten days of April.

The conditions that favor the occurrence of frost are, high or rising barometer, clear weather, light winds, with low humidity in spring and high humidity in autumn.

PORT CRESCENT, WASH.

Precipitation is preceded three to six hours by falling barometer and southeast winds, and the barometer usually falls to about 29.90 or below before precipitation begins. In summer rain begins about the time of the turn in the barometer from falling to rising.

There is generally an increase in relative humidity to about 96 per cent, a few hours before precipitation begins except in summer, when no decided humidity changes have been noted in connection with approaching rain.

Cirro-stratus and cirrus clouds move from the west, but no relation between these or other clouds and rain has been noted at this station.

The high winds of spring, autumn, and winter come from the southerly with falling barometer, and the high winds of summer from westerly with rising barometer.

The warm winds of spring, autumn, and winter come from the southeast, and of summer from the east. The cold winds of summer come from the west, and of other seasons from the northeast.

No damage results from frost at this station.

PORTLAND, ME.

Precipitation is preceded twelve to twenty-four hours by southeast to northeast winds and falling barometer, and the barometer usually falls to 29.90 or below before precipitation begins. In the case of storms that advance northeastward from the south Atlantic coast precipitation begins closely following the shift of wind to northeast and the turn in the barometer from rising to falling.

There is generally an increase in relative humidity two to six hours before precipitation begins.

Cirrus and cirro-stratus clouds moving from the west frequently precede precipitation twelve to eighteen hours.

The highest winds of all seasons usually come from southeast to northeast with falling barometer.

The warm winds of spring and autumn come from the southwest and west, of summer from the west, and of winter from the south. The cold winds of spring and winter come from the northwest, of summer from east and south, and of autumn from west and northwest.

Frost is likely to damage fruit or other crops in April and October.

The conditions that favor frost are, rising and high barometer, temperature falling below 40°, low relative humidity, light west to northwest winds, and few if any clouds.

PORTLAND, OREG.

In all seasons precipitation is preceded by southeast winds and falling barometer. In spring the rain winds set in about fourteen hours, in summer about twelve hours, and in autumn and winter about twenty hours before precipitation begins. In spring, summer, and autumn the barometer usually falls to 29.95 or below and in winter to 30 or below before precipitation begins. Wind shifting from northwest to northeast and then to southeast is a good indication of rain at any season of the year. Wind shifting to northwest is a sign of clearing weather.

The relative humidity usually increases fifteen to twenty-four hours before precipitation begins. An increase of 25 to 50 per cent in relative humidity is a fair indication of rain in spring, summer, and fall.

Cirrus and cirro-stratus clouds are generally followed by rain in spring, autumn, and winter, but are not a good indication of rain in summer. Cirro-cumulus clouds are an almost sure sign of rain in autumn, spring, and winter, but are only a fair indication in summer. Cirro-stratus and cirrus clouds move from the west in spring, summer, and winter, and from the northwest in autumn, and appear thirty to thirty-six hours before rain begins.

The highest wind velocities occur with southerly winds and falling barometer.

The warm winds of spring, summer, and autumn come from the northwest, and of winter from the south. The cold winds of spring and summer come from southeast, south, and southwest, and of autumn and winter from southeast to northeast.

Frost is most likely to damage fruit during the month of April, when prunes, peaches, cherries, and pears are in bloom.

Frost is generally preceded by a rather high or rising barometer, temperature slightly higher than usual, relative humidity 60 to 70 per cent, light to brisk northwest to northeast winds, or light winds if from east or southeast and clear weather.

PORT HURON, MICH.

Precipitation is generally preceded twelve to twenty-four hours by winds that shift to points between south and northeast and increase in force with falling barometer, and the barometer usually falls to 29.80 or below before precipitation begins. During the colder months precipitation often begins soon after the wind goes to northeast and the barometer begins to fall, and snow often continues some hours after the wind shifts to west and northwest and the barometer begins to rise.

In all seasons the relative humidity begins to increase about twelve hours before precipitation; at times, however, the relation between relative humidity and rainfall is not marked.

Cirrus and cirro-stratus clouds observed moving from a westerly direction usually precede precipitation twelve to twenty-four hours, and stratus clouds become more dense on the approach of rain, and in the case of severe storms the movement of stratus clouds is rapid.

High south to northeast winds occur with falling, and high southwest to north winds with rising barometer.

The warm winds of all seasons are from south to southwest, and the cold winds from west to north.

Frost is most likely to damage fruit or other crops after May 1 and before November 1.

The conditions that precede heavy frost are rising barometer, temperature falling in the forties or lower on the day previous, relative humidity normal or below, light winds, and clear or clearing skies.

PUEBLO, COLO.

Precipitation is preceded by northeast winds and falling barometer six to thirty-six hours, and begins after the barometer has fallen to about 29.90 or below in spring, 29.85 or below in summer, 29.95 or below in autumn, and to 30.05 or below in winter, and after the turn in the barometer from falling to rising. In summer, however, rain sometimes begins before the turn in the barometer from falling to rising. In summer, preceding rain which practically always occurs

with thunderstorms, the barometer falls under the influence of the diurnal change; eliminating this change the barometer has a slight upward tendency before rain. During late autumn, winter, and early spring cloudy and threatening weather begins only after the barometer has fallen considerable, and precipitation occasionally begins before the barometer has reached the lowest point, but usually not until after a few hours after the rise begins. Precipitation of any considerable duration occurs only when the barometer rises slowly, or remains low and nearly stationary.

In spring, autumn, and winter there is sometimes an increase in relative humidity six to twenty hours before precipitation. In summer neither an increase nor a decrease has been noted.

Cirrus and cirro-stratus clouds moving from the west are observed almost daily. In the spring cumulus, strato-cumulus, and stratus moving from northeast, east, or southeast are usually followed by rain in a few hours. In winter alto-stratus clouds moving slowly from a westerly direction precede precipitation more frequently than any other cloud formation.

The high winds of this place come from northerly with rising barometer.

The warm winds of spring, autumn, and winter come from south to west points, and of summer from southerly. The cold winds of spring, summer, and autumn come from northeast to east, and of winter from north to east.

In the spring fruit buds are likely to be injured by frost after April 20, garden truck after May 1, tomatoes and melons after May 5, and corn after May 10. In the fall, before October 1, crops are either harvested or advanced beyond the stage where injury from frost will result. Melons and tomatoes continue to ripen until killed by frost, and some years their season continues until October 15.

The conditions that are favorable for heavy frost are: Rising barometer, temperature falling to below 40°, relative humidity increasing to from 60 to 90 per cent, light winds, and clear or clearing weather. Light precipitation during the day, followed by rising barometer and clearing weather at night presents a most favorable condition for frost formation both in spring and autumn.

RALEIGH, N. C.

Precipitation is preceded twelve to twenty-four hours by winds blowing from points between south and northeast, and at times in the spring from southwest, and falling barometer, and the barometer usually falls to 30, or below, before precipitation begins, except when winds are from the northeast during the colder months, when it often begins with higher barometer. In summer rain generally begins about the turn in the barometer from falling to rising, and in other seasons while the barometer is falling.

There is usually an increase in relative humidity twelve to twenty-four hours before precipitation. In spring the change in relative humidity has, however, a rather remote relation to rain; in summer there is often a decided decrease about six hours before thunderstorms; in autumn the increase is generally preceded by a marked decrease in relative humidity; in winter the increase indicates rain, except when due to fog.

Cirrus and cirro-stratus clouds from the west are distinctly forerunners of rain in the winter months, and appear twelve to twenty-four hours before rain begins. During summer, however, cirrus clouds often appear that are not followed by rain. If, during the warmer months, cumulus clouds appear early in the day they are more likely to be followed by thunderstorms than cumulus that appear in the afternoon, but in the latter case, if thunderstorms appear, they will be more violent.

The warmer winds of all seasons come from the southwest, and the colder winds from northwest and north, and, in winter, also from the northeast.

The high winds of all seasons come from the northwest with rising barometer; in the spring and summer, however, the high winds set in or begin from the southwest with falling barometer, and quickly shift to northwest with rising barometer.

Frost is likely to damage fruit or other crops from March 15 to May 10, and during October.

Heavy frost is usually preceded by high or rising barometer, temperature about 40° at 8 p. m. on the evening preceding frost, light winds, and a clear sky.

RAPID CITY, S. DAK.

Precipitation is usually preceded twelve to twenty-four hours by southeast to northeast winds and falling barometer, and begins after the turn in the barometer from falling to rising. In spring and summer the barometer generally falls to 29.80 or below, in autumn to 29.90 or below, and in winter to 30 or below before precipitation begins. As a rule, the barometer has fallen below the points indicated and has been rising several hours before precipitation begins.

The relative humidity decreases about twenty-four hours before rain in all seasons of the year, and low relative humidity is a good indication of precipitation.

Cirrus and cirro-stratus clouds moving from the west usually precede rain or snow. There are no other special cloud characteristics of rain that appear sufficiently in advance of precipitation to be of value in forecasting.

The warm winds of spring and summer come from the southwest, of autumn from the south, and of winter from the south and southwest.

The cold winds of spring, summer, and autumn come from the northwest, and of winter from the north and northwest.

Frost is likely to cause damage from May 10 to September 20.

Heavy frost is usually preceded by rising barometer, temperature falling to 40° or below, high relative humidity, light winds, and few if any clouds.

RED BLUFF, CAL.

In spring, autumn, and winter precipitation is usually preceded twenty-four to thirty-six hours by southeast winds and falling barometer, and the barometer generally falls to 29.80 or below before precipitation begins. In summer no rain falls. As the movement of the barometer at this station depends upon the progress of areas of high and low barometric pressure eastward from the Pacific Ocean, and as all general rains in California are associated with storms that advance from the ocean the barometer falls preceding rain and rises preceding clearing weather. If the rain is to be of long duration the barometer falls slowly, if severe and of short duration the barometer falls rapidly.

The relative humidity increases twenty-four to thirty-six hours before precipitation to over 50 per cent in spring, to over 40 per cent in autumn, and to over 80 per cent in winter.

In spring and autumn cirrus clouds moving rapidly from the westerly precede rain twenty-four to thirty-six hours. In winter the interval between the appearance of upper clouds moving from a westerly direction and the beginning of rain is shorter, but the indication is not so often fulfilled.

The high winds usually come from the southeast with falling barometer, and also from the north with rising barometer.

Frost is most likely to damage fruit or other crops from the middle of February to the middle of April.

Heavy frost occurs in the spring following the passage of a storm, with rising barometer, falling temperature, falling dew-point, and winds changing from southerly to westerly. These conditions are preceded by hail or sleet along the foothills. In autumn frost occurs rarely, and is usually preceded by a thunderstorm. In winter frost is preceded by rising barometer, low humidity, and clearing weather. Severe winter frosts are due to an outflow of air from a cold wave over the plateau region.

RICHMOND, VA.

Winds generally set in from the east quadrants, with falling barometer, twenty-four to thirty-five hours preceding precipitation, and the barometer usually falls to 30 or below before precipitation begins, except in the case of storms that advance from the south or southwest

during the colder months, when precipitation begins closely following the turn in the barometer from rising to falling. In summer showers occur on the turn of the barometer from falling to rising.

There is usually an increase in relative humidity for a period of twelve to twenty-four hours before precipitation in all seasons of the year, the period of increase being longer during the colder months.

Cirrus or cirro-stratus clouds moving from a westerly direction often appear twenty-four hours before precipitation. A fine veil of cirrus, nearly approaching the cirro-stratus, drawn out in parallel threads or wisps like the teeth of a comb, presage precipitation. This formation is rare and has been observed only in spring, late autumn, and winter months.

During periods of abnormally high temperature the wind is generally from the southwest, and the cold winds of all seasons usually come from the north.

Frost is likely to damage fruit or other crops after April 1 and before October 31.

Heavy frost occurs with barometer rising or above normal, temperature 40° or below, relative humidity above 75 per cent, few if any clouds, and light westerly or northerly winds.

ROCHESTER, N. Y.

Precipitation is usually preceded twelve to twenty-four hours by southeast to southwest winds and falling barometer, and the barometer generally falls to about 29.90 or below in spring, 29.85 or below in summer, 29.95 or below in autumn, and 30 or below in winter, before precipitation begins. In the case of storms that come from the south or southwest, however, precipitation often sets in closely following the shift of wind to the northeast and the turn in the barometer from rising to falling.

The relative humidity generally decreases before precipitation in March for a period of about thirty-six hours, and in April and May for an average period of about three days. In summer and autumn the decrease is noted for about two days preceding rain, and in winter the period is about thirty-six hours. In the spring the humidity will often decrease and remain low for several days without rain, and again rain will continue several days with low humidity. Rain begins with relative humidity 50 per cent and above, and dry weather often accompanies high humidity. Decreasing relative humidity generally attends decreasing pressure and increasing relative humidity increasing atmospheric pressure.

Cirrus and cirro-stratus clouds move from the west. In winter and early spring the sky is almost constantly overcast and cirrus and cirro-stratus clouds can seldom be seen. During periods of clear weather, however, their appearance precedes rain for an average

period of about thirty hours. In summer and autumn cirrus and cirro-stratus clouds appearing during a period of clear weather presage rain within twenty-four to thirty hours.

The high winds of this station usually come from southwest to northwest, with rising barometer.

The warm winds of all seasons come from the southwest, and the cold winds from southwest, west, and northwest.

Frost is likely to damage fruit or other crops in late spring and early autumn.

Frost is generally preceded by rising barometer, temperature falling to 40° or below, relative humidity moderately low, light winds, generally from westerly directions, and few if any clouds.

ROSEBURG, OREG.

In spring and summer precipitation is preceded twelve to twenty-four hours by southwest winds and falling barometer, and in winter about twelve hours by southerly winds and falling barometer. In spring and summer precipitation usually begins after the turn in the barometer from falling to rising, and in autumn and winter while the barometer is falling. In spring, summer, and winter the barometer generally falls to 29.90 or below, and in autumn to 29.80 or below before precipitation begins.

In summer there is an increase in relative humidity twenty-four to thirty-six hours before rain; in other seasons the relation between changes in relative humidity and precipitation has not been defined.

In spring and summer cirro-stratus clouds moving from the southwest often precede precipitation twenty-four to forty-eight hours. In autumn and winter cirro-cumulus clouds from the southwest or south precede precipitation twelve to twenty-four hours.

In spring, autumn, and winter high winds come from southerly, with falling barometer. In summer high winds seldom occur, but when they do they come from southeast, east, or northeast.

The warm winds of spring and summer are northerly, and of autumn and winter southerly. The cold winds of spring, summer, and winter come from the northwest and of autumn from the northeast.

Frost is likely to damage fruit or other crops during the late spring.

The conditions favorable for heavy frost are: Barometer high or rising, temperature falling to 40° or below, increasing relative humidity, clearing or clear weather, and light winds.

SACRAMENTO, CAL.

In spring, autumn, and winter precipitation is preceded by northerly shifting to southeasterly winds and falling barometer, and begins near the turn in the barometer from falling to rising. In spring and winter the barometer usually falls to 29.80 or below, and in autumn to

29.90 or below before precipitation begins. Rain sometimes continues several days after the barometer begins to rise. Practically no rain falls in summer.

The relation between atmospheric moisture and precipitation has not been determined at this station.

Cirro-stratus clouds move from the southwest in spring and autumn, and from the northwest in winter; but the relation between cloud forms and precipitation has not been noted by the observer.

High winds come from the northwest with rising, and from south west to southeast with falling barometer.

The warm winds of all seasons come from northwest to north, and the cold winds from southerly directions.

Frost will injure vegetables and garden truck in April and sometimes in May, deciduous fruits in March and April, and citrus fruits in November and December.

Heavy frost is usually preceded by high barometer, north to east winds becoming very light, a low percentage of relative humidity, and a clear sky, though sometimes accompanied by fog.

ST. LOUIS, MO.

During the colder months precipitation is preceded twelve to twenty-four hours by winds from points between south and northeast, and falling barometer, and the barometer usually falls to 29.90 or below in early spring and to 30 or below in winter before precipitation begins. During the warmer months rain is preceded for somewhat longer periods than in winter by winds from southwest to southeast and falling barometer, and the barometer falls to about 29.90 or below before rain begins. In the case of summer showers rain begins about the time of the turn in the barometer from falling to rising, and when the wind shifts from southerly to westerly.

As a rule, the relative humidity increases twenty-four to forty-eight hours before precipitation begins, the period being somewhat shorter in the colder than in the warmer months.

Cirrus and cirro-stratus clouds moving from the southwest are often observed preceding precipitation, and they afford a more reliable indication of precipitation in the colder than in the warmer months. In the spring these clouds change rapidly to alto-stratus and alto-cumulus before rain, and in winter alto-cumulus appear in advance of the precipitation-bearing stratus clouds.

High winds usually come from the western quadrants with rising barometer. In spring, however, high winds often come from the northeast.

The warm winds of all seasons come from the south, and the cold winds from west to northwest.

Frost is likely to damage fruit or other crops in April, and from September 1 to the latter part of October.

In spring and autumn heavy frost is generally preceded by rising barometer, temperature falling to 40° or below, relative humidity 75 per cent or less, light northerly winds, and clear weather.

ST. PAUL, MINN.

Precipitation is preceded eight to twenty-four hours by southerly or easterly winds and falling barometer, and the barometer usually falls to 29.90 or below before precipitation begins.

The relative humidity generally increases two to twelve hours before precipitation, relative humidity 60 per cent in summer, 70 per cent in spring and autumn, and 80 per cent in winter is usually followed by precipitation.

Cirro-stratus clouds from the west in spring, summer, and winter, and from the northwest in autumn are usually followed by precipitation in twelve to twenty-four hours. Precipitation is often preceded by clouds that resemble white sheets with dark, irregular edges, which float slowly from directions between southwest and west. They appear to be a development of the alto-stratus toward the strato-cumulus, and are more common to the summer than to the winter months.

The high winds of spring, autumn, and winter come with rising barometer and from southwest shifting to northwest, and of summer from southeast to southwest with falling barometer.

During periods of abnormally high temperature the wind is from points between southeast and south in spring and autumn, from southeast to southwest in summer, and from southerly in winter. The cold winds of all seasons come from northwest to north.

Frost is likely to damage fruit or other crops in May and September.

Heavy frost is preceded by high barometric pressure, temperature 40°, or slightly below, relative humidity 45 to 60 per cent, light west to northwest winds, and few if any clouds.

SAN ANTONIO, TEX.

Precipitation is usually preceded six to twenty-four hours by southeast winds and falling barometer and, as a rule, begins about the time of the turn in the barometer from falling to rising. In summer the period is somewhat longer. In the case of storms whose centers pass to the south of station the winds go to northerly by way of easterly. In spring the barometer usually falls to 29.90 or below, in summer to 29.95 or below, and in autumn and winter to 30 or below before precipitation begins. Irregular and oscillating barometer, and barometer below the normal with northerly winds, indicates rain.

There is invariably an increase in relative humidity before rain, the period of increase varying from six to forty-eight hours in spring

and summer, six to thirty-six hours in autumn, and six to twenty-four hours in winter. Excessive moisture is always an indication of rain.

Cirro-stratus clouds moving from the west or southwest precede rain by periods that vary from three to forty-eight hours, the periods being greater in autumn and winter. These clouds merge into clouds of lower formation. In spring columnar cumulus, with cirrus haze at low levels, moving from the southeast, indicate strong wind and heavy rain. In summer and autumn cumulo-nimbus banking in the northeast or northwest indicate showers for a day or two; mammillate cumulus from the southeast indicate thunderstorms; and cloud banks in the west or northwest indicate rain. In winter ribbed cirrus, with watery-looking patches at lower level, and hair-rooted cirro-stratus moving from west or southwest presage rain; so also alto-cumulus from southeast with northerly winds.

The warm winds of spring and winter come from south and southeast, of summer from southeast, southwest, and northwest, and of autumn from northeast. The cold winds of spring and winter come from points between west and north, of summer from the northeast, and of autumn from the north.

Fruit is subject to damage by frost in March and April, and garden truck from October to April, inclusive.

Heavy frost is generally preceded by high barometric pressure, a high percentage of relative humidity, temperature 40° or slightly below, light winds, and few if any clouds.

SALT LAKE CITY, UTAH.

In spring precipitation is generally preceded about two days by south to southwest winds and falling barometer, and the barometer falls to about 29.70 and is on the rise before precipitation begins. In autumn and winter southerly winds and falling barometer precede precipitation about two days, and the barometer falls to a minimum of about 29.80 in autumn and to a minimum somewhat above 30 in winter and is on the rise before precipitation begins. In summer northwest winds and falling barometer precede rain about twenty-four hours, and the barometer falls to about 29.85 and is on the rise before rain begins. In spring, autumn, and winter "rain winds" are produced by an area of low pressure passing in over the Washington coast, or the formation of a low area over the northern or middle plateau region. During summer they result from a low area over the northern Rocky Mountain slope and a high area over the north Pacific districts.

The relative humidity has not been associated with weather changes.

Cirro-stratus clouds move from the northwest in spring, autumn, and winter, and from the southwest in summer. From April to September they precede rain two to three days, and from October to March

one to two days. Precipitation is also preceded by cirro-cumulus clouds.

High winds come, with rising barometer, from the north in spring and winter, and from the northwest in summer and autumn.

The warm winds of all seasons come from the southeast, and the cold winds from the northwest.

Frost will damage fruit or other crops from March 20 to June 10.

The conditions that precede heavy frost are a low barometer area moving off toward the southeast or east; a well-marked high area coming in from the northwest; morning temperature between 40° and 50°; relative humidity about 50 per cent; brisk wind, becoming light, and sky clearing of stratus clouds. This applies to all seasons.

SAN DIEGO, CAL.

In spring precipitation is preceded twelve to twenty-four hours by wind blowing from points between southeast and west and falling barometer, and the barometer falls to about 29.90 or below and is on the turn from falling to rising before rain begins. In autumn southeast to southwest winds and falling barometer precede rain twelve to twenty-four hours, and the barometer generally falls to about 29.80 and is on the turn from falling to rising when rain begins. In winter rain is preceded twelve to forty-eight and sometimes seventy-two hours by southeast to southwest winds and falling barometer, and the barometer falls to about 29.80 or below before rain begins. In summer no rain falls. Preceding rain the barometer is subject to rapid fluctuations, rising and falling a few hundredths in the general fall. The height of the barometer is not at all times material. As a rule the heaviest rain begins after the barometer begins to rise. Clearing weather is preceded a few hours by rapidly rising barometer. Often clearing weather and rising barometer are simultaneous. In the spring southeast to south winds with falling barometer or high west winds with stationary barometer indicate rain. "Sonoras" come with falling barometer and a shifting west to northwest wind.

There is usually a decrease in relative humidity for a few hours preceding rain. A drop of 10 to 20 per cent in relative humidity below a normal of 70 per cent generally precedes rain six to twelve hours. Conditions may be ever so threatening—barometer, clouds, wind direction and velocity, etc.—but if the relative humidity is above 70 per cent, precipitation in a form other than mist is improbable.

In spring cirro-stratus clouds from the south precede rain six to twelve hours, in autumn from the west twelve to thirty-six hours, and in winter from points between southeast and southwest twenty-four to forty-eight and sometimes seventy-two hours. Cirro-cumulus clouds

nearly always precede rain. These clouds should be well defined, with darkened convexities. A thick sheet of cirro-stratus clouds will sometimes herald a general rain. During the rainy season a very small streamer-like cloud of a dark shade is generally entwined about a threatening cumulus cloud and always precedes rain. The observer has called these clouds "rope stratus," from their appearance, and they apparently indicate a state bordering on complete saturation. These clouds have no independent direction, but depend on the movement of the accompanying cumulus cloud. Other conditions may be very threatening, but if the clouds have a wave-like appearance, with their crests inclined to the south, no rain will fall. These clouds are frequently seen on the western horizon, and clearly indicate the direction of the upper air currents. The direction of these upper projections, whether they point south or north, indicates respectively fair weather or rain.

In spring and winter high winds come from southeast to southwest points with falling barometer, and from east to north points with rising barometer. No high winds occur in the summer and autumn.

The warm winds of the colder months come from points between east and north. No high temperature occurs in summer. The cold winds of spring, autumn, and winter come from east to northeast points. There are no low temperatures in summer.

Citrus fruit may be damaged by frost at any time of the year, but the critical time for oranges is just before picking, which is generally from December 1 to February 1.

The general conditions which precede heavy frost are: Rising barometer, low temperature and humidity, northerly winds, no clouds, or a streamer-like appearance of filmy cirrus.

SANDUSKY, OHIO.

Precipitation is usually preceded twelve to twenty-four hours by south to southeast winds and falling barometer, and the barometer falls to 29.85 or below in spring and winter, and to 29.80 or below in summer and autumn before precipitation begins. In the case of storms that advance from the south or southwest the wind sets in from points between east and northeast, and precipitation often begins closely following the beginning of the fall in the barometer.

In spring and winter there is an increase in relative humidity twelve to twenty-four hours before precipitation, and in summer there is a slight increase, twelve to thirty-six and sometimes forty-eight hours before rain begins.

Cirrus clouds moving from the west or southwest have often been observed one to two days preceding precipitation.

The high winds of this station generally come from west to northwest with rising barometer.

The warm winds of all seasons are from southerly, and the cold winds from westerly and northerly in spring and winter, and from northeast, north, or northwest in summer and autumn.

Frost is likely to damage fruit or other crops in the spring after April 1 and in the fall during October.

Frost is preceded by rising barometer, temperature falling to 40° or below, increasing relative humidity, light westerly winds, and clear or clearing weather.

SAN FRANCISCO, CAL.

In spring and autumn rain is preceded twenty-four to forty-eight hours by southeast winds and falling barometer, and the barometer usually falls to 29.80 or below in spring, and to 29.90 or below in autumn before rain begins. In summer little or no rain falls. In winter southeast to southwest winds and falling barometer precede rain twelve to forty-eight hours, and the barometer usually falls to 29.80 or below before rain begins. With "Sonora" storms rain sometimes begins with the local barometer 30.10 or above. A marked low barometer area moving southward along the coast in winter presages rain; a marked high area, fair weather.

An increase in relative humidity is noted six to twelve hours before rain in spring, a slight increase about six hours before in autumn, and an increase twelve to twenty-four hours before in winter. The moisture of the air indicates rain to a slight extent only.

In spring and autumn cirrus clouds moving from the northwest often precede rain twenty-four to forty-eight hours. In winter cirrus clouds from the northwest, and sometimes from the south, precede rain about twenty-four hours. Cirro-cumulus changing rapidly to alto-stratus clouds indicate rain in winter.

In spring and summer high west to north winds come with rising barometer, and in autumn high west winds attend rising and high barometric pressure. In winter high southeast winds occur with falling barometer.

Abnormally high temperature is of rare occurrence and usually comes with northerly winds. No low temperatures are experienced.

Late spring frosts in March and April damage the buds of deciduous fruits. Frosts of December, January, and February damage ripe citrus fruit.

Heavy frost is likely to occur with barometer above 30 and stationary or rising, temperature falling to 40° or below, northerly winds, and clear weather.

The general distribution of barometric pressure that is favorable for frost in California is low barometric pressure over southern California and southern Arizona and high barometric pressure over the middle and northern Rocky Mountain and plateau districts.

SAN LUIS OBISPO, CAL.

In spring, autumn, and winter precipitation is usually preceded twenty-four to forty-eight hours by southerly winds and falling barometer, and rain generally begins about the time of the turn in the barometer from falling to rising. As a rule the barometer falls to 29.95 or below in spring and winter and to 30 or below in autumn before rain begins. After falling, the barometer rises during rain until clearing weather occurs.

Owing to the proximity of this station to the sea the humidity of the air affords but a slight indication of approaching rains. A decrease in relative humidity is, however, sometimes noted twenty-four to thirty-six hours before rain.

Cirro-stratus clouds moving from points between south and west often precede rain about forty-eight hours. A thin blanket of lead-colored cirro-stratus clouds slowly spreading and finally covering the sky may be obscured in a few hours.

High winds come with rising barometer and from westerly points in spring, and from north or west in summer, autumn, and winter.

The warmer winds of all seasons come from the north, and also the cooler winds, except in summer, when the cool winds are from westerly.

Frost is likely to damage fruit in the spring.

Heavy frost usually attends high barometric pressure, temperature falling to 40° or below, high relative humidity, northerly winds, and a few cirrus clouds.

Frost is generally followed by rain within forty-eight hours.

SANTA FE, N. MEX.

Generally throughout the year steadily falling barometer with southerly winds for one to two days indicate precipitation, but precipitation seldom begins until after the turn in the barometer from falling to rising, and the wind has shifted from southerly to colder north and northeast. In summer the conditions that precede rain are not so well marked as during the winter months.

In winter and spring the relative humidity often increases during the twenty-four hours before precipitation, while in summer and autumn an increase in relative humidity is noted only immediately preceding the beginning of rain.

In spring and winter precipitation is usually preceded thirty-six to forty-eight hours by cirrus clouds moving from the west or southwest. The presence of cirrus clouds does not, however, necessarily indicate precipitation.

The highest winds of winter and spring are from northerly and westerly, and of summer and autumn from southerly and westerly.

In all seasons south to southwest winds prevail during periods of abnormally high temperature, and north to northeast winds during periods of abnormally low temperature.

Frost is likely to damage fruit or other crops from April 1 to May 15, and from October 1 to November 15.

The general conditions which precede heavy frost are low barometer, high temperature and humidity, and southerly winds, followed by rising barometer, falling temperature, and winds shifting to north and northeast, bringing snow on adjacent mountains.

SAVANNAH, GA.

In spring and winter south to southwest winds and falling barometer precede precipitation twenty-four to thirty hours. In summer rain is preceded about twenty-four hours by southwest winds and falling barometer, and in autumn about twenty-four hours by southerly or easterly winds and falling barometer. In all seasons the barometer generally falls to 30 or below before precipitation begins.

While, as a rule, increasing moisture is shown twelve to twenty-four hours in advance of rain in the warmer, and twenty-four to thirty-six hours in advance during the colder months, it is not believed that the humidity of the air at this, a seacoast station, possesses special value as an indicator of rain.

In well-defined rain periods, due to more or less pronounced storm areas moving across the country, cirro-stratus clouds, moving from the west in spring, summer, and winter, and from the southwest in autumn, precede precipitation for an average period of about twenty-four hours. At times the cirro-stratus clouds are followed by alto-stratus, and more frequently by alto-cumulus, clouds.

High winds generally come from south and east quadrants with falling, and from west and north quadrants with rising, barometer.

The warmer winds of spring and winter come from south and southwest, of summer from southwest, and of autumn from northeast. The cold winds of spring are from northwest to north, of summer and autumn from the northeast, and of winter from west, northwest, north, and northeast.

The critical period for damage by frost is during the months of March and April.

As a rule, the barometer is high and rising slowly twelve to twenty-four hours in advance of the occurrence of heavy frost, showing the near approach of a crest of high barometric pressure. On the day preceding frost the maximum temperature seldom exceeds 55°, with cloudless sky, light to fresh northwest wind, and relative humidity rather lower than usual. These general conditions appear both in spring and autumn.

SAULT STE. MARIE, MICH.

In all seasons precipitation is preceded twelve to eighteen hours by south to southeast winds and falling barometer, and the barometer usually falls to 29.90 or below before precipitation begins. In the case of storms from the south or southwest, however, precipitation often begins with higher barometer and shortly after the wind sets in from the northeast.

No note has been made by the observer of the relation between atmospheric moisture and precipitation. Neither has the relation between cloud formation and movements been noted.

The high winds of this station usually come from the northwest with rising barometer.

The warm winds come from the south and east in spring, autumn, and winter, and from southeast to southwest in summer. The cold winds of spring, summer, and autumn come from the northwest, and of winter from northwest to northeast.

Frost is likely to damage fruit or vegetables after May 20 and before September 20.

Heavy frost is usually preceded by barometer normal or above, temperature falling to 34° or 36°, average humidity, light west to north winds, and clear sky.

SCRANTON, PA.

Precipitation is usually preceded twelve to twenty-four hours by winds from points between south and northeast and falling barometer, and the barometer generally falls to 30 or below before precipitation begins. In connection with storms that advance from the south or southwest, precipitation often closely follows the shift of the wind to northeast and the turn in the barometer from rising to falling.

There is usually an increase in relative humidity eight to twelve hours before precipitation begins.

Cirrus and cirro-stratus clouds moving from a westerly direction generally indicate precipitation within twelve to eighteen hours.

The warm winds of all seasons come from south or southwest, and the cold winds from northwest and north.

Frost is likely to damage vegetation early in May and late in September and early in October.

Heavy frost is usually preceded by slowly rising and high barometer, temperature falling to 40° or below, low relative humidity, light west to north winds, and clear sky.

SEATTLE, WASH.

Southeast to southwest winds usually precede precipitation six to eighteen hours in spring, twelve to thirty-six hours in summer, twelve to eighteen hours in autumn, and six to twelve hours in winter.

A steady fall in the barometer to quite a distance below the normal is considered an indication of rain, and, as a rule, the greater the fall in the barometer the heavier the rain. In spring rain generally begins after the barometer begins to rise after a marked fall, in summer about the time the barometer has reached the lowest point, and in autumn and winter usually while the barometer is falling. The height of the barometer when rain begins varies with the position and distance of the storm center and the amount of the central depression. A gradual rise above the normal barometer is an indication of fair weather. A rapid rise in the barometer does not indicate settled weather.

As the air is always moist the relative humidity does not afford an indication of weather changes, except that a decrease is sometimes noted twenty-four to forty-eight hours before rain in summer and twelve to eighteen hours before rain in autumn. In autumn also an excess of moisture in the air causes dense fog.

In spring and autumn cirro-stratus clouds moving from west or northwest precede rain twelve to twenty-four hours. In winter cirro-stratus clouds are quickly followed by a veil or bank of stratus or strato-cumulus and then rain follows usually in six to twelve hours. In summer the indications of cirro-stratus are not so reliable. A leaden-colored veil of stratus clouds first appearing in the south and gradually spreading toward the zenith presages rain at all seasons. Mount Rainier, 65 miles SSE., is early obscured. Clear visibility of Rainier in the afternoon is a sure sign of fair weather for about twenty-four hours.

High winds come from the south and southeast with falling, and from southwest to northwest—and sometimes in winter from north and northeast—with rising, barometer.

The warm winds of spring are from the north, of summer and autumn from northwest and north, and of winter from south and southwest. The cold winds of spring and autumn are from northeast, of summer from south, and of winter from northeast to north.

Frost will cause damage in the latter part of March and the first ten days in April, when fruit trees are generally in bloom; apples sometimes bloom as late as the third decade of April, but usually by the 10th. Tender vines are damaged by frost in May, and late vegetables in September and early October.

Heavy frost is usually indicated by barometer rising rapidly and high for the season, falling temperature, low relative humidity, west to northwest winds, high cumulus or cirro-cumulus clouds from the northwest rapidly dissolving or clearing away, and a crisp feeling in the atmosphere.

SHREVEPORT, LA.

Precipitation is preceded one to three days by south or southeast winds and falling barometer, and the barometer usually falls to about 29.90 or below in spring, and to 30 or below in summer, autumn, and winter, before precipitation begins. In all seasons except winter precipitation does not generally begin until after the turn in the barometer from falling to rising. In the colder months northeast winds often precede rain.

As near as could be ascertained from the records, there is an increase in relative humidity twenty-four to forty-eight hours in advance of precipitation; at times, however, there has been a decrease in relative humidity preceding precipitation.

Cirro-stratus clouds moving from the west seem to precede the beginning of precipitation for an average period of about thirty-six hours, and alto-cumulus clouds moving from the south often precede rain about twelve hours.

High winds come from south and southeast with falling, and from northwest with rising, barometer.

The warm winds of all seasons come from the southeast, and the cold winds from the northwest.

Frost is likely to cause damage in April, May, September, and October.

Heavy frost is usually preceded by rising barometer, falling temperature, decreasing relative humidity in spring and autumn, and increasing in winter, light northwest to north winds, and lower clouds clearing away. In 75 per cent of the cases examined rain had fallen within forty-eight hours preceding the occurrence of frost.

SIOUX CITY, IOWA.

Precipitation is usually preceded twelve to twenty-four hours by southeast to northeast winds and falling barometer, and the barometer generally falls to 29.90 or below before precipitation begins. In spring and summer rain begins while the barometer is falling, and in autumn and winter after the turn in the barometer from falling to rising.

An increase in relative humidity usually occurs twelve to twenty-four hours before precipitation, but the cases are common when a decrease occurs during the same period.

Cirro-stratus clouds advance from the west during the warmer, and from the northwest during the colder, months. No relation between the appearance of these or other cloud forms and precipitation has, however, been established.

During periods of abnormally high temperature the winds come from south in spring and autumn, and from south and southwest in summer

and winter. The cold winds of all seasons come from northwest and north.

Frost is likely to damage tender vegetation after May 1, and before September 30.

The conditions that precede frost are, rising barometer, temperature falling to 40° or below, low relative humidity, and clearing sky.

SPRINGFIELD, ILL.

Precipitation is usually preceded twelve to twenty-four hours by winds that set in from points between south and east—and sometimes from northeast during the colder months—and falling barometer, and the barometer generally falls to 30 or below before precipitation begins. Precipitation usually begins while the barometer is falling, except during the warm months, when showers often begin about the time of the turn in the barometer from falling to rising.

There is generally an increase in relative humidity about twenty-four hours before precipitation, but the increase appears to be less marked in summer than during the colder months. In general a high dew-point indicates rain, but rain often quickly follows a low dew-point.

Cirro-stratus and cirrus clouds are generally considered forerunners of precipitation, when other conditions are favorable. When these clouds appear during the day, precipitation is likely to begin during the night; and when they are observed in the morning, rain begins in the afternoon.

The warm winds come most frequently from south and southwest, and the cold winds from northwest, except in summer, when they come from the northeast.

Frost is most likely to damage fruit or other crops in April, May, September, and October.

Heavy frost is usually preceded by rising and high barometer, falling temperature, low relative humidity, light winds, and clear or clearing weather.

SPRINGFIELD, MO.

Precipitation is preceded twelve to thirty-six hours by southeast to east winds and falling barometer, and the barometer usually falls to 29.90 or below in spring, to 29.95 or below in summer and autumn, and to 30 or below in winter before precipitation begins. In all seasons precipitation generally begins with falling barometer, except during the warmer months, when showers begin with the turn in the barometer from falling to rising.

During the colder months there is generally an increase in atmospheric moisture twenty-four hours before precipitation. In summer excessive moisture, as indicated by a muggy and oppressive condition of the air, is a good indication of thunderstorms.

Cirrus and cirro-stratus clouds moving from the west in spring and autumn, from southwest or west in summer, and from west or northwest in winter often precede precipitation twenty-four to thirty-six hours. Cirrus followed by alto-stratus clouds, increasing in density, indicate rain; also rapidly moving scud stratus in the morning. Cumulus banking in the west or northwest in the evening are a good indication of rain; and also alto-stratus changing to stratus and becoming denser.

The warmer winds of spring and winter come from south and southeast, of summer from south, and of autumn from south to southwest. The colder winds of all seasons come from points between west and north.

Frost is likely to cause damage about the middle of April and early in October.

Heavy frost is usually preceded by high or rising barometer, temperature about 40° at the evening observation, low relative humidity, light northwest to north winds, and clear weather.

SPOKANE, WASH.

Precipitation is generally preceded twelve to forty-eight hours by southeast to southwest winds and falling barometer, and the barometer usually falls to 29.90 or below before precipitation begins. In all seasons, except summer, precipitation generally begins with falling barometer.

An increase of relative humidity has been observed twenty-four to forty-eight hours before precipitation; at other times the relative humidity has seemingly decreased, but as observations of the humidity are made in general only at twelve-hour intervals it is believed that an increase in humidity preceding precipitation is often unobserved.

Cirro-stratus clouds advance from the southwest, and the average interval between their first appearance and the beginning of precipitation, when precipitation follows, is about twenty-four hours; the cirro-stratus cloud formation is, however, seldom observed at this station. When conditions are becoming favorable for rain, stratus or strato-cumulus are generally the clouds that immediately precede or indicate rain. Cirrus clouds may be observed for days at a time in summer and autumn before rain, and more often no rain will follow. At times, and particularly in winter and spring, a sheet of stratus assumes a baggy, greasy appearance, resembling the festoons that precede thunderstorms, but on a larger scale; this formation is considered a good indication of precipitation. If stratus clouds move from a southerly direction precipitation is expected within twenty-four hours. In winter there sometimes appears a thin stratus formation, resembling cirro-stratus, through which the sun may be seen, but without halo; this formation is considered an indication of snow, when moving from a southerly direction.

High winds usually occur a few hours before the barometer reaches its lowest point, and continue after the barometer begins to rise, shifting from southwest to west.

The warm-winds of spring and winter come from south and southwest, and of summer and autumn from east to northeast. The cold winds come from east and northeast in spring and winter, and from southwest to west in summer and early autumn.

From April 1 to May 15 is the most critical time for damage to fruit by frost; and also the period between October 15 and November 15, when the winter apple, which is the staple fruit of this section, is subject to damage.

Barometer above the normal and a clear sky precede heavy frosts. The evening before frost occurs the temperature may be as high as 60°, and the relative humidity about 50 per cent, and with pressure and weather conditions favorable frost will occur. At such times the temperature will fall during the night to near 32°, and the relative humidity becomes high, often 100 per cent. Although the heavier frosts seem to come with the wind from points between north and northeast, light winds from other directions occur when other conditions favor their occurrence.

TACOMA, WASH.

South to southwest winds and falling barometer usually precede precipitation six to eighteen hours, and the barometer generally falls to 29.90 or below before precipitation begins. Rapidly falling barometer with a storm central off the coast of Vancouver Island furnish conditions favorable for heavy rain. Rising barometer with wind shifting to westerly indicate clearing weather. High and steady barometer indicates continued fair weather.

Humidity is usually very high in the Puget Sound region, and the observations taken do not afford sufficient data for a deduction of facts regarding the relation of atmospheric moisture and rain. The relative humidity is frequently low during rain, and again 100 per cent of relative humidity is sometimes unaccompanied by rain.

Owing to the regularity of the "wet" and "dry" seasons but little dependence can be placed on cloud observations. During the "dry" season the observation is always "smoke" or "stratus," and in the winter it is nearly always "stratus" or "nimbus." Cirro-stratus clouds, when observed, advance from points between southwest and northwest.

The high winds of this station usually come from the southwest with rising barometer, except when storm centers pass to the south, when north to east gales are experienced.

The warm winds of spring and winter come from south and southwest, and of summer and autumn from the north. The cold winds of all seasons come from the north.

Frost is likely to cause damage in March and April, when fruit trees are in bloom. All crops and fruits are harvested long before the first killing frost in the autumn or winter. The observer's experience here leads him to believe that much of the damage to fruit that is attributed to frost is really caused by cool, rainy weather, which prevents the flight of bees and other insects, upon which the fruit blossoms have to rely for the act of fertilization.

Conditions for the occurrence of frost are, high barometer, falling temperature, average humidity, light winds, and clear weather.

TAMPA, FLA.

In spring rain is usually preceded three to twelve hours by southwest winds and falling barometer and begins on the turn of the barometer from falling to rising. Summer is the wet season, and rain is generally preceded for a variable period by southeast winds and begins about the time of the turn in the barometer from falling to rising. In autumn northeast winds and falling barometer usually precede rain three to twelve hours, and rain begins when the barometer has reached the lowest point and is on the upward turn; rain often occurs without visible premonitory indications, and again in anticyclonic areas on the turn in the barometer from rising to falling. In winter southerly winds and falling barometer usually precede rain three to twelve hours, and rain begins while the barometer is falling and sometimes continues with west to northwest winds and rising barometer. While the barometer generally falls to 29.90 or below in spring and summer, and to 30 or below in autumn and winter before rain begins, rain will occur with any abnormal change or height of the barometer.

The relative humidity increases one to three hours before rain, but a high percentage of relative humidity is not necessarily an indication of rain.

Cirrus and cirro-stratus clouds are occasionally observed moving from a westerly direction in spring, summer, and winter, but, except at times in summer, afford no indication of rain.

High winds come from south to east points with falling, and from west and northwest with rising, barometer.

The warm winds of spring come from the southeast, of summer from south to southeast, of autumn from the northeast, and of winter from east to south points. The cold winds of spring, summer, and autumn come from the north, and of winter from northwest and north.

Frost is likely to damage fruit or other crops from November 15 to April 15.

In autumn and winter heavy frost is preceded by barometric pressure rising to 30.20 or above, temperature 50° or below, relative humidity between 70 and 80 per cent in autumn and between 60 and 80 per cent in winter, light northwest winds, and clear weather or a few upper clouds.

TOLEDO, OHIO.

Precipitation is preceded twelve to twenty-four hours by southerly to easterly winds and falling barometer, and the barometer usually falls to about 29.85 or below before precipitation begins. When storms advance from the south or southwest precipitation often begins closely following a shift of wind to the northeast and the turn in the barometer from rising to falling.

While there is an increase of relative humidity preceding precipitation when winds are from the easterly, a decrease occurs with winds from southerly quarters. When the wind shifts from southerly to cooler easterly preceding rain the relative humidity increases. In itself the relative humidity can not be considered an indicator of precipitation.

Cirrus and cirro-stratus clouds are always observed moving from a westerly direction, and often appear eight to thirty-six hours in advance of precipitation. Clouds of this formation thicken rapidly and merge into lower clouds preceding precipitation.

High winds come from south and southwest with falling, and from west and northwest with rising, barometer.

The warm winds of spring come from south and west, of summer from southwest, and of autumn and winter from south and southwest. The cold winds of spring come from northwest to northeast, of summer from north to northeast, of autumn from west to northwest, and of winter from southwest to northwest.

Frost is likely to damage fruit or other crops from about April 15 to May 20 and during September.

The conditions that precede heavy frost are high barometer, low temperature for the season, low relative humidity at preceding observation, light winds, and clear weather.

VALENTINE, NEBR.

Southeast to east winds and falling barometer generally precede precipitation twelve to forty-eight hours, and the barometer usually falls to 29.80 or below in spring, to 29.90 or below in summer, and to 30 or below in autumn and winter before precipitation begins. In spring and winter, precipitation begins after the turn in the barometer from falling to rising, and in summer and autumn about the time the barometer begins to rise after a fall. In a majority of cases precipitation does not follow either a rapid fall or rise in the barometer. A

slow and steady fall in the barometer, with an unsettled appearance of weather conditions, more often precedes precipitation.

In all seasons an increase in relative humidity begins twenty-four to thirty-six hours before precipitation, and a decrease occurs just before precipitation begins. A high percentage of relative humidity does not necessarily indicate precipitation.

Cirrus and cirro-stratus clouds move from the west and northwest, but can not be depended upon as indicators of precipitation. In summer large masses of ominous looking strato-cumulus clouds moving swiftly from the southwest, west, or northwest precede rain; and in autumn heavy masses of cumulus, if they last until afternoon, will sometimes cause heavy showers. In winter, precipitation is often preceded by cirro-cumulus clouds followed by a gradually thickening veil of low stratus, which moves very slowly.

High winds generally start in from southerly and shift to west and northwest with rising barometer.

The warm winds of all seasons blow from points between south and west, and the cold winds from northwest and north, and in winter from points between northwest and northeast.

Frost is likely to cause damage after May 1.

In spring frost is generally preceded by rising barometer, temperature below normal, and relative humidity increasing to 80 or 90 per cent. In autumn, frost generally occurs after a long cloudy spell, with or without precipitation, with rising barometer, temperature falling to 38° or below, high relative humidity, west to northwest winds, and clear or clearing weather.

VICKSBURG, MISS.

Precipitation is usually preceded six to thirty-six hours by south to southeast winds and falling barometer, and the barometer generally falls to about 29.95 or below in spring and autumn, to 29.90 or below in summer, and to 30 or below in winter before precipitation begins.

During the colder months there is generally a slight increase in relative humidity during a period of about six hours before precipitation begins, and during the warmer months there is a slight decrease during a corresponding period.

Cirrus and cirro-stratus clouds move from the west, and when precipitation can be associated with their appearance it occurs two to three days after they appear. No other characteristics of cloud formation that presage rain have been noted by the observer.

The warm winds of all seasons come from south and southeast. The cold winds of spring, autumn, and winter are northeasterly, and of summer easterly.

Frost is likely to damage fruit or other crops in March, April, and October.

Twenty-four hours preceding frost the barometer generally ranges near or above 30.30 over northern Texas and higher to the westward or northward, with the 40° isotherm dipping well into Texas. Frequently heavy rainfall occurs within forty-eight hours preceding heavy frost. Light northerly winds attended by clear or clearing weather and decreasing humidity usually prevail during twenty-four hours preceding heavy frost.

WALLA WALLA, WASH.

Precipitation is generally preceded four to six hours by southerly winds and falling barometer, and the barometer generally falls to 29.90 or below before precipitation begins. In spring, autumn, and winter precipitation begins on a falling barometer, and in summer on the turn in the barometer from falling to rising. The barometer generally falls rapidly preceding rain.

There is, as a rule, a slight increase in relative humidity three to four hours preceding precipitation.

Cirrus and cirro-stratus clouds moving from a westerly direction usually presage precipitation within twenty-four to thirty-six hours, and precipitation is immediately preceded by stratus clouds moving rapidly from the south or southwest.

The high winds of all seasons come from the southwest with falling barometer.

The warm winds of spring come from the southwest, of summer from south and southwest, and of autumn and winter from the south. The cold winds of spring come from the south, of summer from the northeast, of autumn from the north, and of winter from the southeast.

Frost is likely to cause damage from about the middle of April to the early part of June.

Heavy frost is preceded by barometer above the normal, temperature falling to 40° or below, high relative humidity, light easterly winds, and few, if any, clouds.

WASHINGTON, D. C.

In connection with areas of low barometric pressure that advance to the Atlantic coast from the west or west-northwest the wind sets in from the southeast quadrant with falling barometer twelve to thirty-six hours before precipitation begins, and the barometer usually falls to 30 or below before the beginning of precipitation. In connection with areas of low barometer that advance from the south or southwest precipitation frequently begins closely following the shift of wind to the northeast, and often with high but falling barometer; this is particularly the case during the colder months, when moisture contained

in the comparatively warm easterly winds from the ocean is condensed by the lower temperatures of the interior.

The easterly winds that precede precipitation are of a necessity moist winds, and the humidity of the air increases when the wind sets in from these quarters. During the colder months increasing humidity is therefore an indication of precipitation when the increase is attended by falling barometer. During the summer months, also, an increase in humidity to indicate rain must be attended by barometric conditions that attend an approaching area of low barometer.

Cirrus and cirro-stratus clouds move from westerly directions and are, as a rule, forerunners for periods of twelve to eighteen hours of precipitation. The appearance of these clouds indicates a barometric disturbance to the westward; they do not, however, invariably indicate precipitation; at times the barometric disturbance will not possess sufficient strength to cause precipitation. Cirrus and cirro-stratus clouds that precede precipitation gradually thicken and merge into alto-stratus and finally into stratus clouds that assume the direction of the surface wind. Other cloud formations, such as summer cumulus, that precede precipitation are rain-carrying clouds when barometric and wind conditions favor rain, and do not appear sufficiently in advance of precipitation to be of value in forecasting.

The high winds of all seasons are generally from southerly shifting to westerly with rising barometer. In connection with southern storms, however, gales of exceptional violence sometimes come from the east quadrants.

During periods of abnormally high temperature the wind generally comes from points between south and west. The cold winds of late spring come from the northeast quadrant; in other seasons the cold winds come from the northwest.

Frost is likely to damage fruit or other tender crops during April and the early part of May, and from late in September through October.

Heavy frost in spring and autumn is preceded by barometer above the normal or rising rapidly, temperature falling to 40° or below, decreasing relative humidity, clear or clearing weather, and light winds from westerly quarters.

WICHITA, KANS.

Precipitation is usually preceded twelve to twenty-four hours by winds from points between south and east and falling barometer, and the barometer generally falls to 29.90 or below in spring to 29.80 or below in summer and autumn and to 30 or below in winter before precipitation begins. In all seasons precipitation begins, as a rule, on falling barometer, but during the late autumn, early spring, and winter months the beginning of precipitation is sometimes delayed until

after the turn in the barometer from falling to rising. At such times the wind goes to north quadrants before the beginning of precipitation attending the passage of a storm center south of the station.

In summer and autumn there is a marked decrease in relative humidity twelve to twenty-four hours before rain. During the colder months the change in the moisture of the air preceding precipitation is not marked.

Precipitation does not always follow the appearance of cirrus or cirro-stratus clouds, but when it does the interval between the appearance of these clouds and the beginning of precipitation varies in length from eighteen to twenty-four hours. The cirro-stratus clouds gradually cover the whole sky, becoming denser, and merge into clouds of alto-stratus and stratus formation.

The highest winds of all seasons come from northerly quadrants with rising barometer.

The warm winds come from the south and from a little west of south, but not from the southwest. The cold winds of all seasons come from the north.

Frost is likely to cause damage as early as March 25, but generally from April 1 to May 15. Damage is rarely caused by fall frosts.

The conditions that favor the occurrence of frost are, barometer above 30, temperature falling to 36° or below, relative humidity 80 per cent or more, clear weather, and little or no wind.

WILMINGTON, N. C.

Precipitation is preceded twelve to thirty-six hours by winds from points between southeast and northeast and falling barometer, and the barometer generally falls to 30 or below before precipitation begins. At times, however, when the wind sets in from the northeast during the colder months, the interval is not so great and the barometer does not fall as low as stated.

Beyond the fact that "rain winds" are easterly winds and are necessarily moist winds, no definite relation between relative humidity and approaching rain has been discovered.

Cirrus and cirro-stratus clouds move from westerly and are considered forerunners of rain for an average period of about thirty-six hours.

High winds come from southwest and northeast with falling barometer.

The warm winds of all seasons come from the southwest, and the cold winds from the north.

Heavy frost in spring and autumn is preceded by barometer rising and above the normal, temperature falling to 40° or below, low relative humidity, clearing or clear weather, and light winds from the northwest quadrant.

WILLISTON, N. DAK.

Precipitation is usually preceded about twelve hours by southerly winds and falling barometer, and the barometer generally falls to about 29.80 or below in spring and summer to 29.90 or below in autumn and to 30 or below in winter before precipitation begins. In spring and autumn, precipitation usually begins on a falling barometer, in summer about the time of the turn in the barometer from falling to rising, and in winter on a rising barometer.

There is usually a slight decrease in relative humidity preceding precipitation, but the relation between changes in atmospheric moisture and precipitation have not been noted.

Cirro-stratus clouds from westerly quarters are considered indicators of precipitation, but the period of interval between their first appearance and the beginning of precipitation has not been observed.

The high winds of all seasons come from west, northwest, and north with rising barometer.

The warm winds of spring come from south and southwest, of summer and winter from points between south and west, and of autumn from south and southeast. The cold winds of all seasons come from northwest and north.

The soil products of this section are not subject to damage by frost, the only fruit grown being a few strawberries, and the principal crop, hay.

Frost will occur in the spring and fall when the temperature falls below 40°, with high barometer, high relative humidity, light northwest to north winds, and clear or clearing weather.

WINNEMUCCA, NEV.

In spring and summer, rain usually falls in the form of thunderstorms with westerly winds and is preceded about twenty-four hours by winds blowing from points between southeast and south. In autumn and winter, winds from south to southeast precede precipitation nine to twelve hours. In spring the barometer generally falls to 29.80 or below in summer to 29.75 or below and in late autumn and winter to 29.90 or below before precipitation begins.

Observations of the relative humidity of the air are not considered of value in forecasting, for, although decreasing atmospheric moisture in spring and summer indicates rain, and increasing humidity in autumn and winter indicates rain or snow, these changes occur so frequently without precipitation that they are of value in foreseeing storms only when considered in connection with other atmospheric conditions.

The sky in this dry climate is seldom free from upper clouds, but weeks will sometimes pass without rain. In the spring upper clouds

from the south are often followed by rain in eighteen to twenty-four hours. In summer cumulus clouds from the southward that are met by clouds coming from another direction are frequently followed by showers and thunderstorms in twelve to fourteen hours. In autumn and winter, upper clouds from the north or northeast are generally followed by precipitation in twelve to eighteen hours. Cirrus and cirro-stratus clouds move from points between southwest and west.

The high winds of this station come from the southwest quadrant with falling barometer.

The warm winds of all seasons come from south to southwest points, and the cold winds from north and northeast.

Fruit is likely to be damaged by frost from April 15 to May 15, and garden produce from August 15 to September 15.

Frost is usually preceded by low but rapidly rising barometer, high and rapidly falling temperature, high relative humidity, and southerly winds with light rain followed by wind going to northerly.

YUMA, ARIZ.

While the barometer generally falls and the wind comes from south and east quadrants before precipitation the winds that immediately precede rain are squalls, entirely local, and of varying directions and intensity.

In summer and winter there is usually an increase in relative humidity three to six hours before rain. Increasing moisture in summer indicates showery conditions and precipitation in adjacent localities. In winter high humidity occurs, in the absence of wind, by reason of excessive evaporation from river and irrigated areas.

In summer cirrus clouds from the southwest sometimes precede showers two to six hours. In other seasons cirrus clouds appear moving from west or southwest, but the definite relation that may exist between the appearance of these clouds and conditions favorable for precipitation have not been determined.

The high winds of spring, autumn, and winter come from the north with rising barometer, and of summer from southeast shifting to southwest winds and rising barometer.

In this section frost will cause damage from the middle of December to the middle of February.

Heavy frost is preceded by rising barometer, temperature falling to 40° or below, low but increasing relative humidity, decreasing wind becoming very light, and clear weather.

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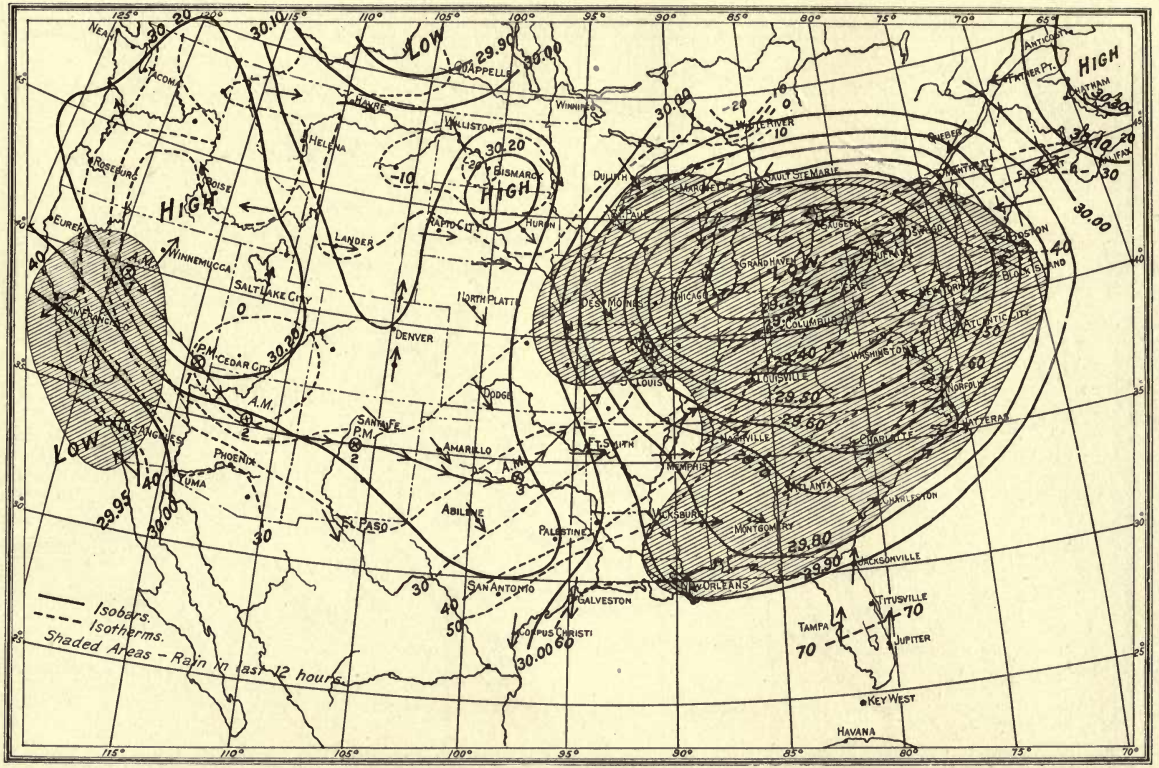
LOW
HIGH
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Isobars.
Isotherms.
Shaded Areas – Rain in last 12 hours.
Seattle
Tacoma
Roseburg
Boise
Helena
Havre
Williston
Bismarck
Rapid City
Huron
Winnipeg
Duluth
Minneapolis
St. Paul
Sault Ste Marie
Marquette
Port Arthur
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White River
Qu'Appelle
Winnipeg
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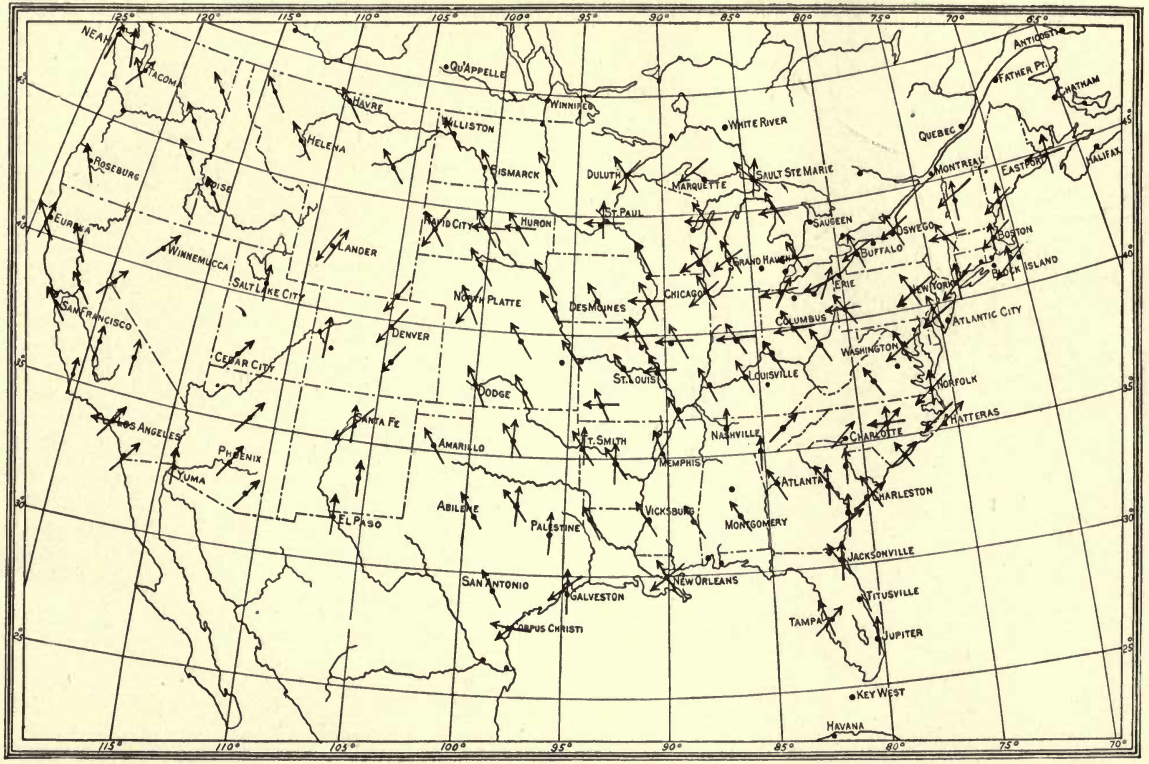
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CHART III. RAIN WINDS. SUMMER.

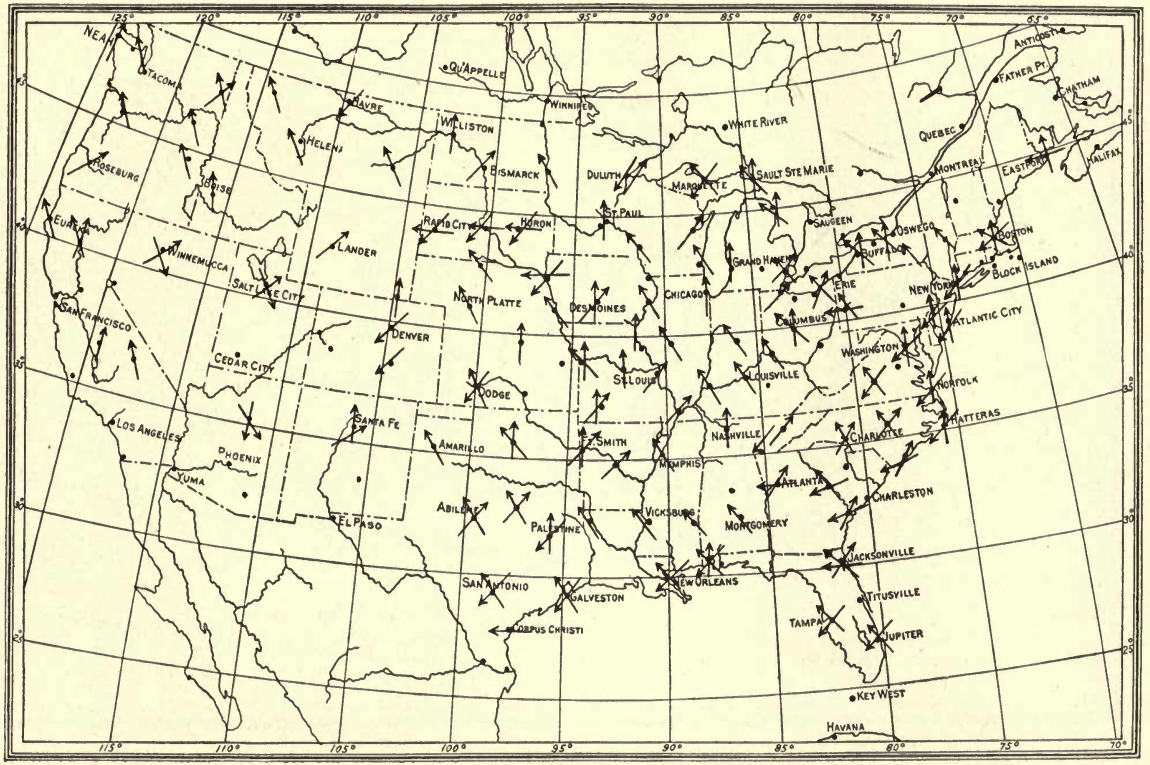

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CHART IV. RAIN WINDS. AUTUMN.

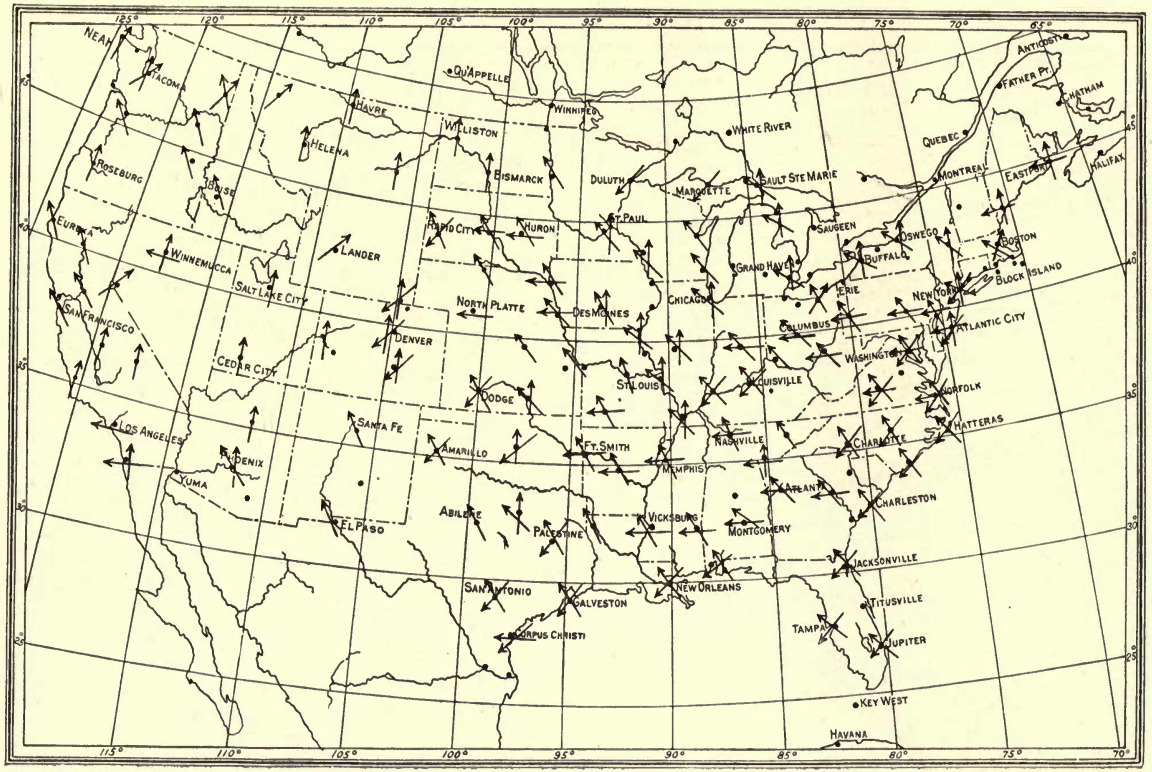

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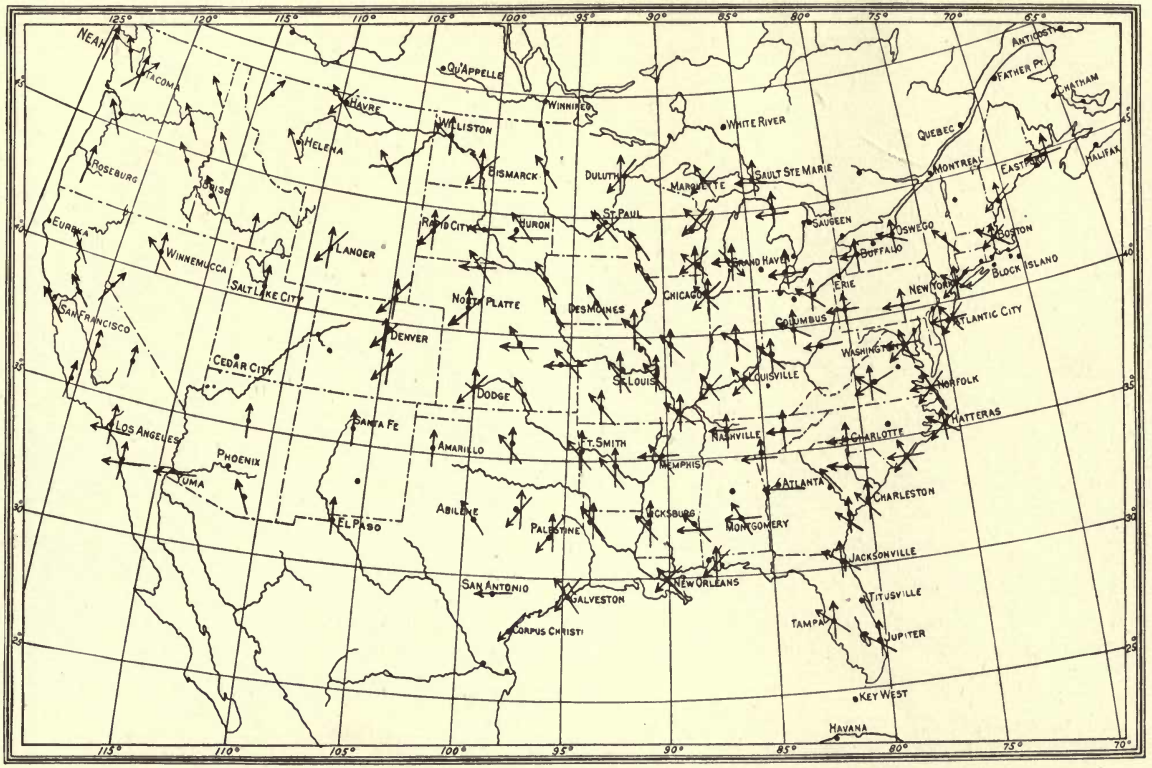
CHART V. RAIN WINDS. WINTER.



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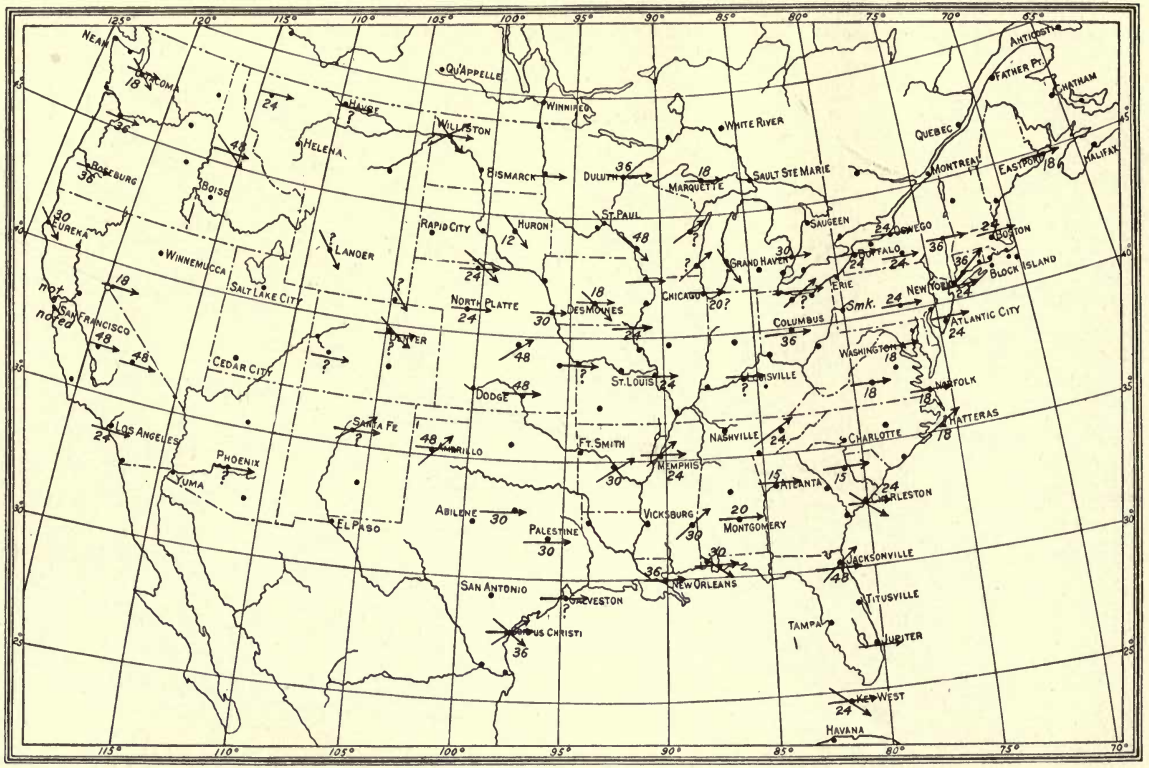

Figures indicate average number of hours clouds were observed before precipitation begins.

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CHART VII. CIRRUS OR CIRRO-STRATUS CLOUDS BEFORE RAIN—DIRECTION AND TIME. SUMMER.

Figures indicate average number of hours clouds were observed before precipitation begins.

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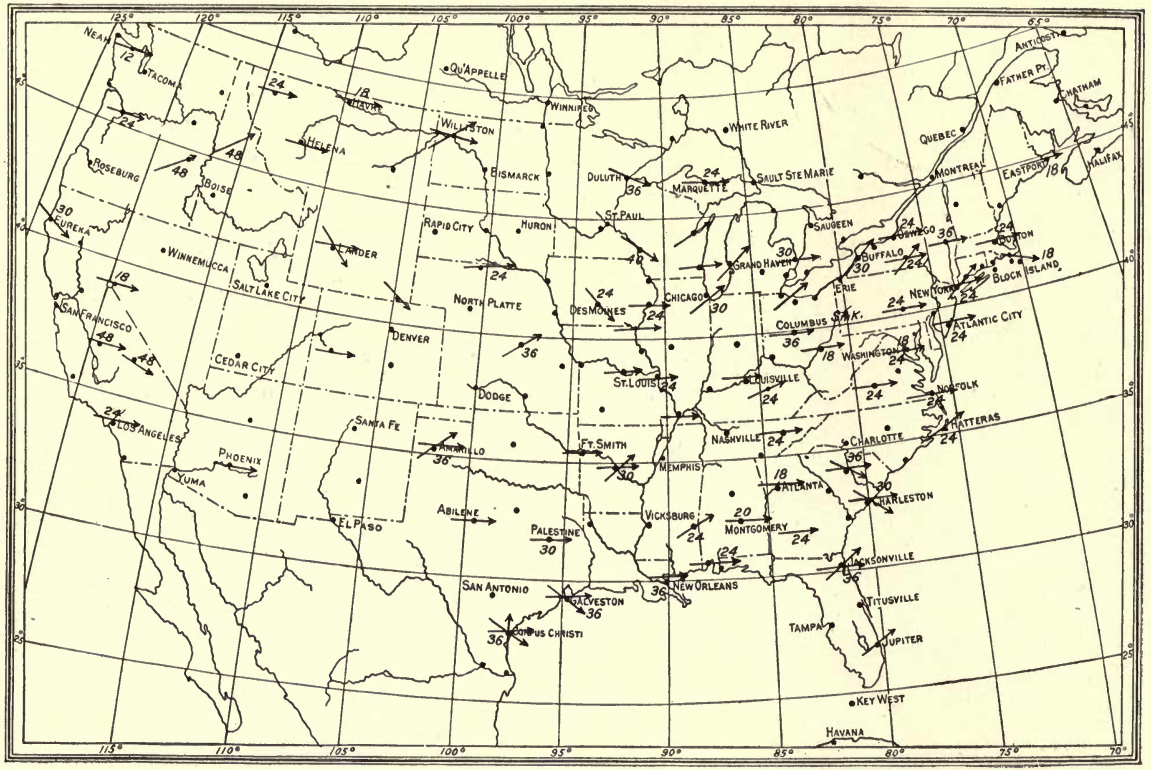
CHART VIII. CIRRUS OR CIRRO-STRATUS CLOUDS BEFORE RAIN—DIRECTION AND TIME. AUTUMN.



Figures indicate average number of hours clouds were observed before precipitation begins.

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CHART IX. CIRRUS OR CIRRO-STRATUS CLOUDS BEFORE RAIN—DIRECTION AND TIME. WINTER.

Figures indicate average number of hours clouds were observed before precipitation begins.

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Correction.—The following note should not appear on Charts X to XIII: "Figures indicate average number of hours clouds were observed before precipitation begins."

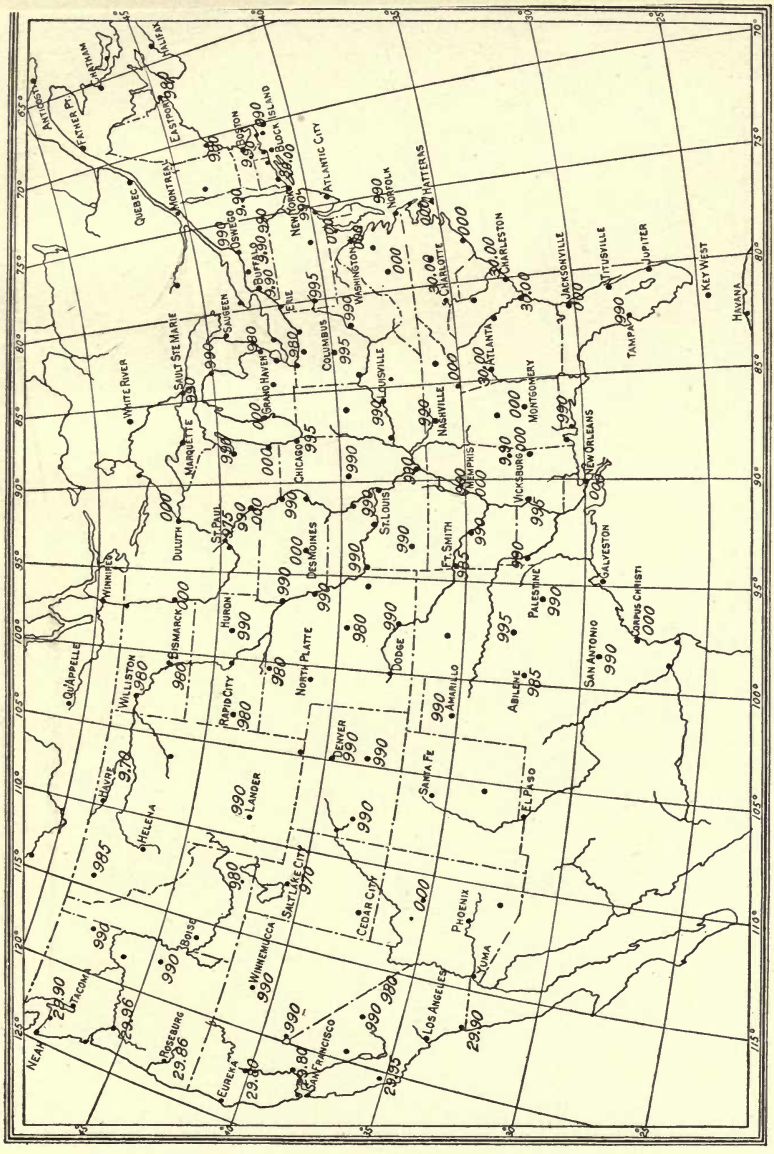
CHART X.
BAROMETER HEIGHT PRECEDING PRECIPITATION.
SPRING.
Figures indicate average number of hours clouds were observed before precipitation begins.

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CHART XI. BAROMETER HEIGHT PRECEDING PRECIPITATION. SUMMER.

Figures indicate average number of hours clouds were observed before precipitation begins.

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CHART XII. BAROMETER HEIGHT PRECEDING PRECIPITATION. AUTUMN.

Figures indicate average number of hours clouds were observed before precipitation begins.

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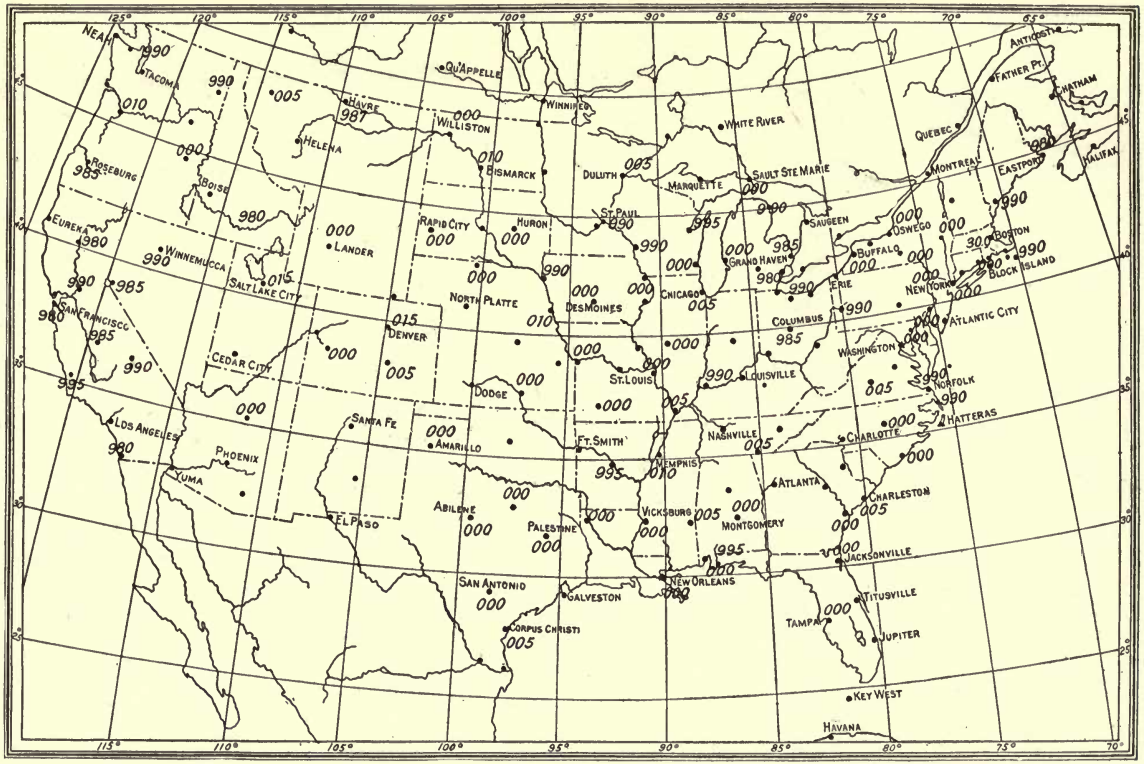

Figures indicate average number of hours clouds were observed before precipitation begins.

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CHART XIV. WIND DIRECTIONS DURING PERIODS OF HIGH TEMPERATURE. SPRING.

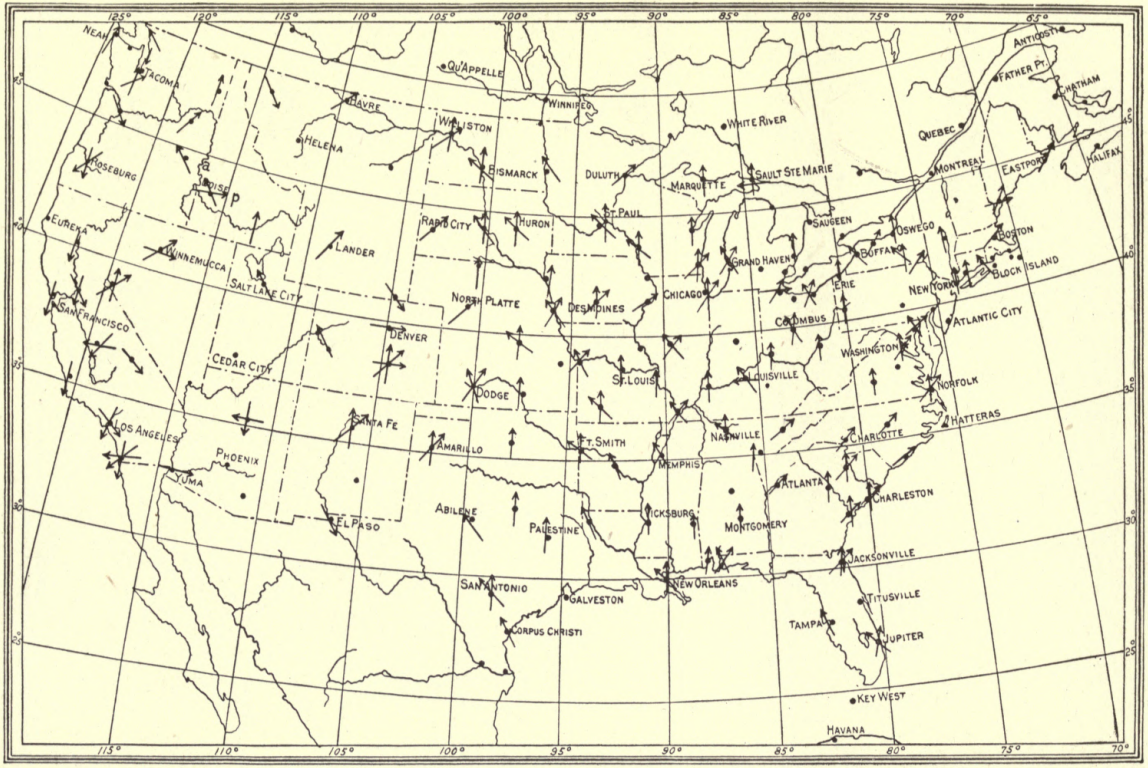

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CHART XV. WIND DIRECTIONS DURING PERIODS OF HIGH TEMPERATURE. SUMMER.

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CHART XVI. WIND DIRECTIONS DURING PERIODS OF HIGH TEMPERATURE. AUTUMN.

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CHART XVII. WIND DIRECTIONS DURING PERIODS OF HIGH TEMPERATURE. WINTER.

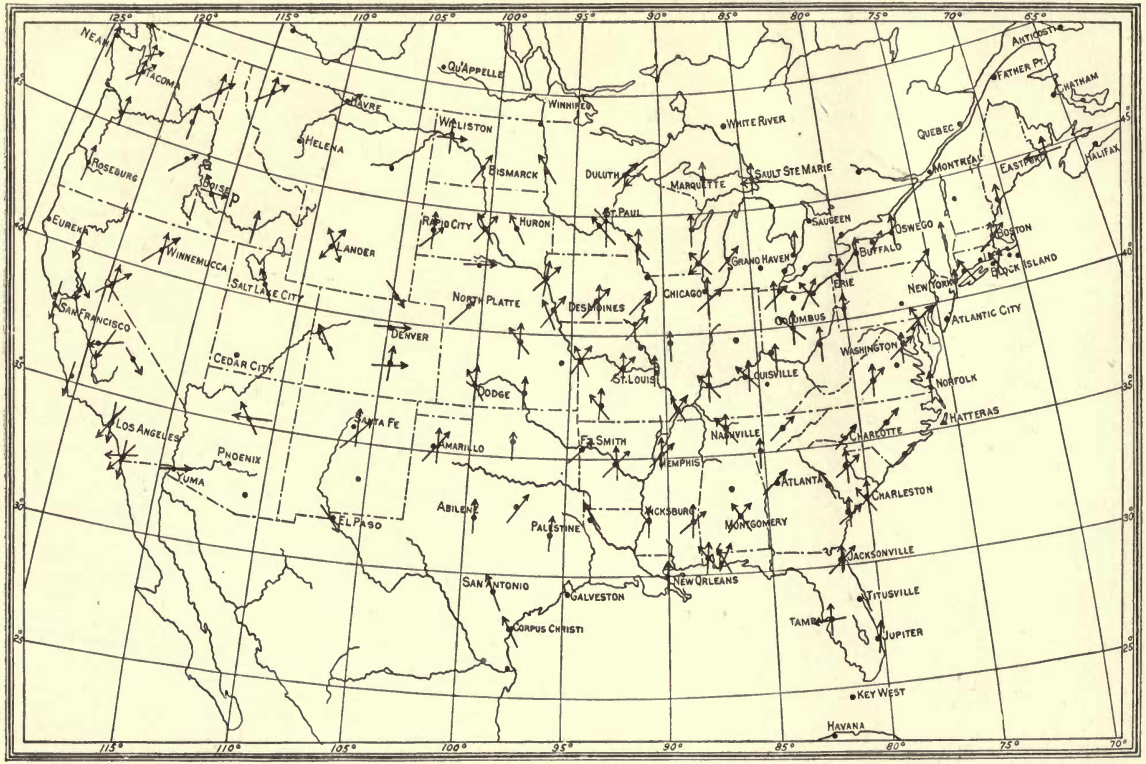

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CHART XVIII. WIND DIRECTIONS DURING PERIODS OF LOW TEMPERATURE. SPRING.

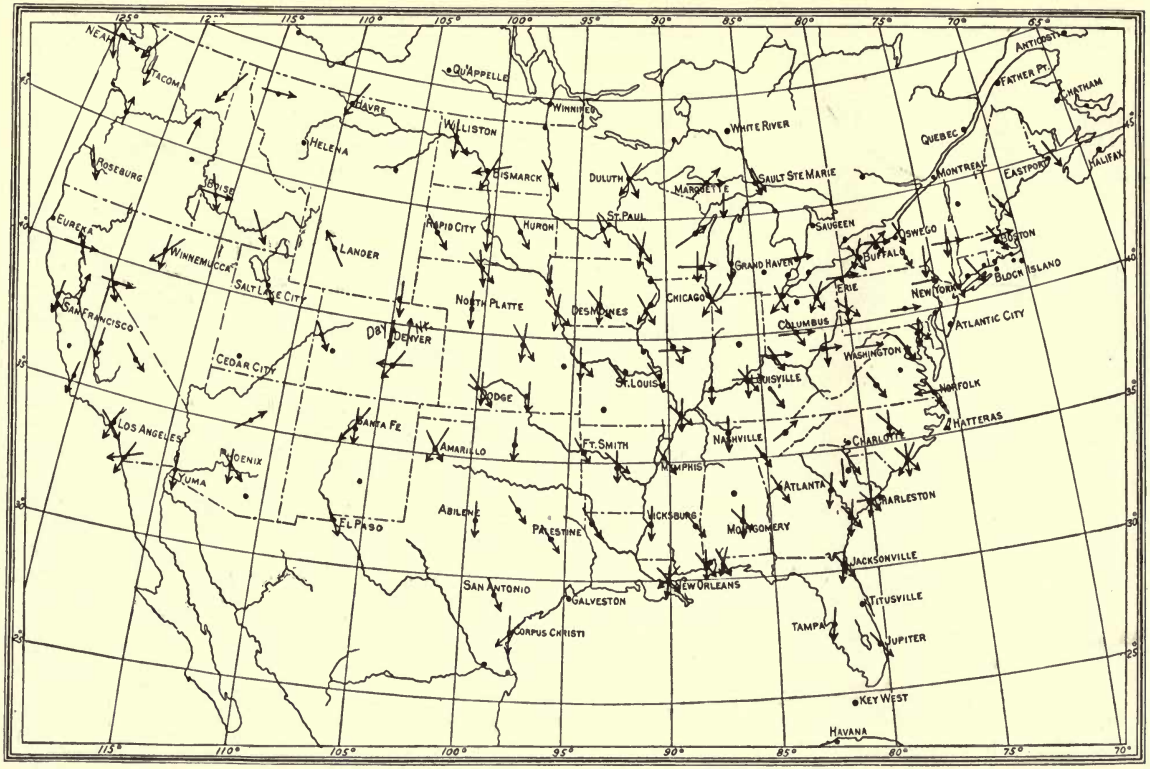

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CHART XIX. WIND DIRECTIONS DURING PERIODS OF LOW TEMPERATURE. SUMMER.

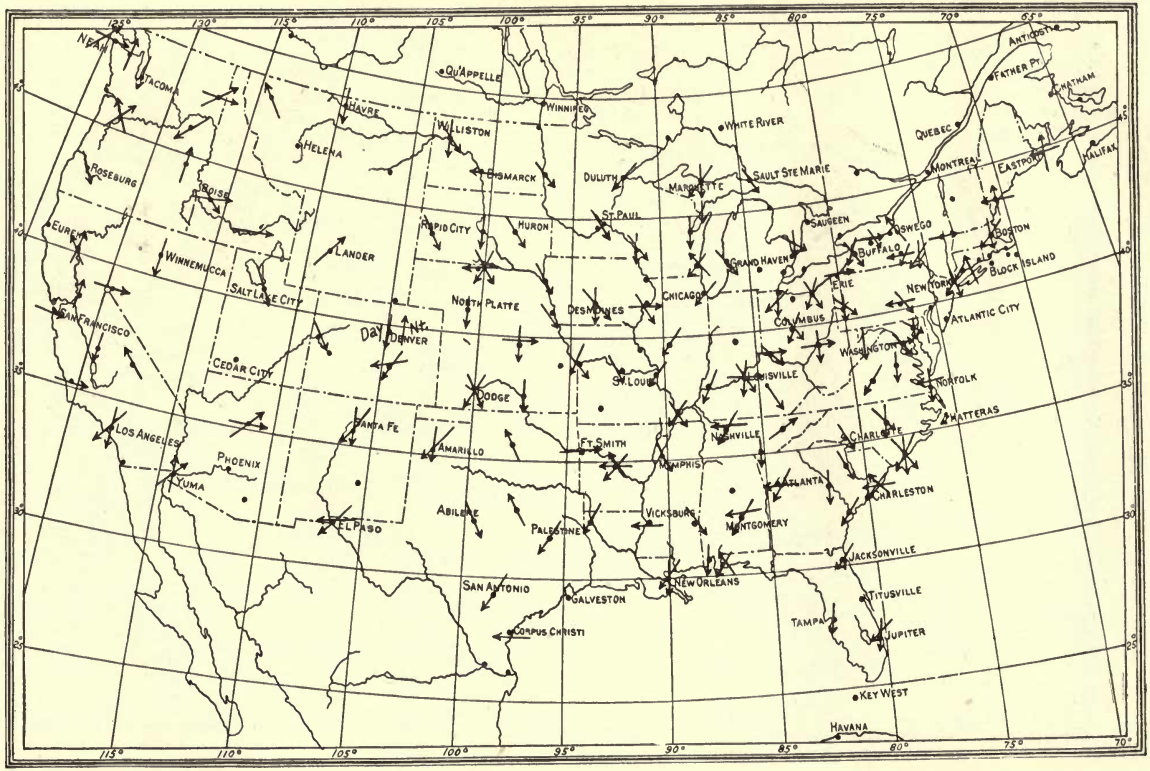

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CHART XX. WIND DIRECTIONS DURING PERIODS OF LOW TEMPERATURE. AUTUMN.

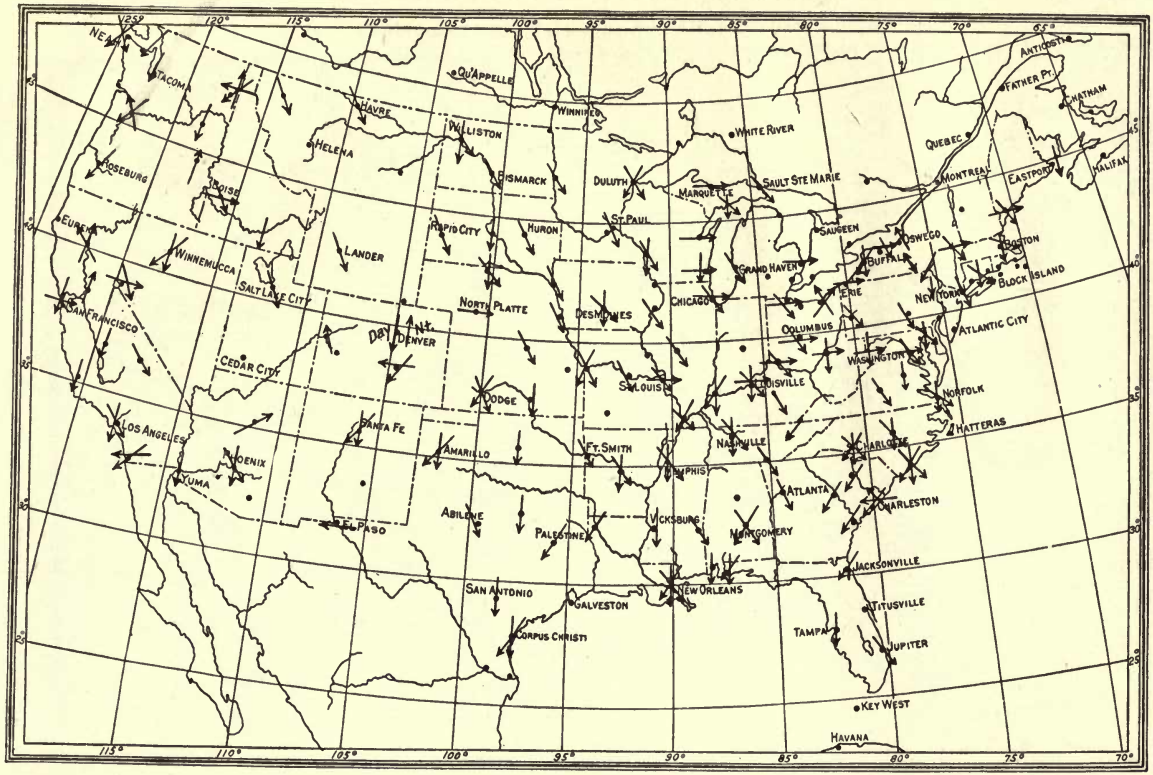

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CHART XXI. WIND DIRECTIONS DURING PERIODS OF LOW TEMPERATURE. WINTER.

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